Rethinking the Role of Index Insurance — Accessing Markets for the Poor[1]

Paper Presented at Weather-Index Insurance for Smallholder Farmers in Africa: Lessons learned and Goals for the Future

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Introduction

In recent years, the development community has become actively engaged in the application of index insurance as a means of addressing financial market failures associated with correlated weather risk that threatens the livelihoods of many of the world's rural poor. Accompanying this growing attention and investment is an expectation that index insurance will follow the path of microfinance and other types of microinsurance products (e.g., life insurance) in reaching some degree of standardization which would result in widespread growth in these markets. However, this enthusiasm may not be fully justified. The mixed results of many weather index insurance pilots to date and lack of widespread implementation of even those considered successful has resulted in a reexamination of what adjustments are needed for these products to become scalable and sustainable (Mechler, Linnerooth-Bayer, and Peppiatt, 2006; Skees et al., 2007; Hellmuth et al., 2009; Hazell et al., 2010). This document reviews the potential development role of index insurance as a tool for transferring catastrophic weather risk out of rural communities that are vulnerable to extreme weather shocks and other natural disaster risks. The synthesis is based on recent pilot experiments and our own research and experience.

The application of weather index insurance in lower income countries is still fairly new, with less than ten years of pilot implementation. This is a relatively limited amount of experience considering the time often required for financial innovations to emerge and take hold. Even more time is needed to assess the longer-term development impact such efforts are expected to produce. For comparison, consider microfinance which has more than thirty years of experimentation and implementation. Its use has become widespread, but questions as to its value for poor households and the magnitude of welfare effects remain (Armendáriz de Aghion and Morduch, 2005).

Failure to openly communicate these uncertainties, learn from past mistakes, or incorporate lessons of success may lead to funding of poorly structured projects that hold little promise. If a number of index insurance tests fall short of expectations, widespread enthusiasm is likely to be followed by disillusionment and withdrawal of support. Considering the crippling effects of unmanaged weather risk — its role in perpetuating poverty and in stymying economic growth — it would be unfortunate to discourage future investments in an innovative instrument that has the potential to address at least certain aspects of financial market failures associated with correlated risk.

What is evident from the experience to date is that weather index insurance must be developed both in the context of the risk and the needs and constraints of the target market. Certain concepts and features of the risk transfer mechanism may be replicable (e.g., regulation, delivery channels, financing structure), but outcomes are ultimately influenced by unique characteristics of the local context such as the risk profile, availability of data, cultural practices, other risk management programs, and critically, the institutional capacity of local implementation stakeholders (e.g., insurance providers, regulators, etc.). For this reason an easily replicable "off-the-shelf" product that can easily be transported is unlikely to emerge.

Because of limitations imposed by the local context, index insurance programs require significant upfront investments in market development and capacity building, which suggest limited potential for quick replication. Experience with insurance varies significantly across countries and regions, and weather index insurance markets are usually absent in lower income countries. Thus, scalability will be limited by the extent to which sustainable market foundations have been laid through investments in public goods such as weather data infrastructure, the education and capacity building of local implementation actors, and the development of an appropriate legal and regulatory framework that can address the unique characteristics and supervisory challenges associated with index insurance. These are large up-front investments which the private sector has been reluctant to assume. Thus far, the funds required for catalyzing a market for index insurance have been supplied by the donor community.

Because outside support carries the risk of creating dependency, it is critical to product sustainability that capacity building occurs among local partners so they can manage the market as donor support is phased out. Moreover, transferring capacity from outside facilitators to local stakeholders allows index insurance to evolve and adapt to the needs of the target market, which is an important condition for scalability and sustainability. Building a sustainable market foundation will expedite scale up and, by reducing the high transaction costs of initial setup, encourage the introduction of additional new insurance products.

This document is about market-based index insurance products, i.e., commercial insurance products priced to reflect the risk exposure that include the usual loading and are not reliant on subsidies to cover long-term operating costs. A market-based approach ensures that the cost of the assumed risk is clearly communicated to consumers and other stakeholders for basing decisions, such as whether it is valuable to invest in risk mitigation, to expand activity, or exit a current economic activity that is simply too risky. We focus on two general classes of products that have been developed for market-based index insurance programs: those designed for households (i.e., index-based microinsurance products) and those for risk aggregators (sometimes referred to as meso-level products).

Risk aggregator refers to firms such as financial institutions (e.g., microfinance entities and other lenders) and value chain enterprises (input suppliers, output processors, transporters, etc.) whose businesses are negatively affected by the correlated weather risks in a geographic region, either through direct losses or through the effects of the catastrophe on their clients or customers. For example, given the spatially correlated nature of drought risk, lenders are affected by the drought exposure of their agricultural borrowers. If a drought occurs, many borrowers could be expected to experience repayment difficulties concurrently. Likewise, other firms in the value chain (e.g., processors or exporters) may experience disruptions to their business due to the widespread effects of a natural disaster. Products designed to protect these risk aggregators are intended to protect the solvency of the firms and improve access to their services. As we discuss later, the target market for the index insurance product (household or risk aggregator) has significant implications for product feasibility and design, such as which data sources can potentially be used to support the insurance offer.

Index insurance products have often been designed with the intention to protect against crop-yield losses due to adverse weather risk; however, other designs are also possible such as contracts that protect a household's livelihood portfolio more generally from a specific, severe weather risk, or other natural disasters. In fact, as will be discussed later, insuring against a range of consequential losses for a specific weather event rather than against the failure of a specific crop is frequently a more effective risk management strategy for both households and risk aggregating firms.

Vulnerability to natural disasters imposes severe limitations on rural economies and the livelihoods of many of the world’s poor. There are socioeconomic welfare benefits to be attained through the management of catastrophic risk which motivates a thoughtful examination of what interventions are most productively pursued and scaled. Weather index insurance may be able to serve this function in certain contexts with potentially substantial impacts. However, we will argue that the pathways of these impacts are likely to initially be indirect (i.e., through the development of risk aggregator products) rather than direct (household products).

Practitioners who design and develop of index insurance products face many challenges. Products are not easily replicable and require large up-front investments in capacity building and product development. Lower income countries — the primary market for index insurance — tend to lack adequate data-generating infrastructure, an obstacle to pricing the product and alleviating basis risk. Few local stakeholders have experience with index insurance, which tends to make implementation a slow and arduous task that requires great commitment and fortitude. With these challenges in mind, we have developed a set of recommendations for developing sustainable and scalable index insurance markets. Although some of these recommendations may be contrary to conventional thought, they are grounded in: 1) a careful reevaluation of experiences with index insurance, including our own; 2) fundamental principles of economic theory; and 3) with recognized scalability and sustainability challenges in mind. We distinguish between recommendations that are related to the process of developing weather index insurance and recommendations that deal with product design.

Recommendations for the Process of Developing Weather Index Insurance

- Focus on legal and regulatory issues from the start;
- Replicate process not products;
- Subsidize start-up costs and the market-failure layer not premiums; and
- Assess impacts.

Recommendations for Product Design

- Focus on risk aggregators first;
- Think beyond protecting against yield losses for a single crop; and
- Focus on catastrophic events.

Although holding considerable potential as a tool for poverty reduction and economic development, index insurance also faces challenges and limitations that must be considered in light of opportunity costs of resources not allocated to alterative development strategies. Donors, academics and practitioners are yet to reach a consensus regarding the conditions that warrant investing in index insurance, how to design sustainable and scalable products while offering real value to clients, and the role that index insurance plays in broader development strategies. This document aspires to stimulate an exchange of ideas with practitioners and academic colleagues thereby advancing the scientific knowledge with regard to the development and provision of index insurance based risk management programs. Since this document is envisioned as part of an educational forum, we welcome any feedback and comments.

Section 1 Risk, Insurance, and Economic Growth

Projects to develop index insurance markets in lower income countries are motivated by a desire to stimulate economic growth and reduce poverty. This section of the document presents a theoretical discussion of how catastrophic weather risks contribute to poverty and how index insurance markets can have a role in managing these risks to stimulate economic growth and contribute to poverty reduction.

1.1 Poverty

For our purposes, poverty can be conceptualized as a household's inability to generate per capita income in excess of a level sufficient to meet basic consumption needs. This definition is based on the notion of poverty line, an imperfect yet convenient measurement based on a threshold (e.g., monetary, nutritional, etc.) below which individuals are considered poor (Ray, 1998).

A great many factors can contribute to the existence of poverty. Among these are: insufficient quantity or quality of household productive assets; limited access to competitively priced production inputs; limited access to processing and marketing opportunities further down the supply chain; inadequate production technologies; limited access to competitively priced credit; lack of communication or transportation infrastructure; and poor law enforcement and/or judicial systems. These causative factors are typically interrelated. For example, insufficient assets may be compounded by limited access to competitively priced credit. A lack of access to processing and marketing opportunities may be due to poor transportation infrastructure.

Understanding the interrelated causes of poverty in any given community is crucial for determining what, if any, interventions should be employed. An important related question is, "How long are households likely to remain in poverty?" Some households experience poverty as a transitory phenomenon due to illness, loss of employment, or extreme weather events such as drought or flooding. While the shock creates temporary difficulties, these households have sufficient access to markets and levels of household assets that they would be expected to eventually recover and generate income levels in excess of the poverty line. Other households experience poverty as a chronic phenomenon. Because they lack access to critical markets and/or lack sufficient levels of household assets, they remain trapped in poverty.

1.2 Capital Flows

Among the many factors mentioned that contribute to the existence of chronic poverty, a common element is the lack of access to capital. Households can lack assets because they lack access to capital sources from which to fund the purchase of additional assets or improve the quality of existing assets. Households can lack access to competitive input markets because input suppliers lack access to capital or to processing and marketing opportunities because firms in those industries lack access to capital with which to expand their supply of those services. Similarly, the lack of technology, infrastructure, and even law enforcement and judicial systems can be explained, in part, by a lack of access to capital.

But this limited access to capital is itself a puzzle. Standard economic theory indicates that there are diminishing marginal returns to capital. This implies that areas with relatively little capital (such as rural areas of lower income countries) should provide opportunities for relatively higher rates of return on capital investments. Thus, capital should flow naturally from capital-rich developed countries to capital-poor lower income countries. Those in developed economies with funds to invest benefit from the higher rates of return offered in lower income countries while those in lower income countries benefit from increased access to capital that can be used to improve the quantity and/or quality of assets.

So why does capital not flow naturally from capital-rich areas to capital-poor areas in search of higher rates of return? There are a number of reasons but scholars generally agree that a major inhibitor of capital flows is risk and the high transaction costs required to reduce risk (Besley, 1995, Armendáriz de Aghion and Morduch, 2005). A central premise of this document is that for rural regions in many lower income countries the lack of efficient (low transaction cost) mechanisms for transferring catastrophic weather risk contributes to low levels of capital investment and thus, limited economic growth (Collier, Skees, and Barnett, 2009).

1.3 Credit

Credit markets are a primary mechanism for facilitating capital flows. Credit creates opportunities to leverage non-liquid assets (e.g., land and human skills) into liquid productive capital. Credit markets also allow borrowers to leverage wealth intertemporally. The borrower pays a price (the interest rate) to have a sum of money that will be repaid in the future. In other words, the borrower is leveraging their future wealth in hopes of increasing their current productivity.

Borrowers pursue credit based on the expectation that the benefit of the credit (of having access to the productive capital) is greater than the interest they pay for this leveraging. The lender is willing to accept this tradeoff only if convinced of the borrowers' ability to generate sufficient future income to repay the loan with interest. When borrowers have access to credit, the monetary net benefits (the value of increased current productivity minus the interest cost) can be reinvested to further increasing the assets of the household or business, setting it on a higher growth trajectory.

To see how extreme weather risk can interfere with this process, consider a financial institution whose customers are geographically concentrated in a rural area prone to spatially correlated weather shock such as drought. Many households in this area are poor and depend heavily on income derived from agricultural production. Similarly, many local businesses either provide services to agricultural producers or sell consumer goods to households dependent on agriculture. When a drought occurs, a large proportion of the financial institution's customers will simultaneously experience dramatic income shortfalls. Agriculturally dependent households will experience lower incomes due to crop losses. Many businesses will also suffer as households in the area will now purchase fewer production inputs and consumer goods.

Savings deposits at the financial institution will be withdrawn to cover consumption needs and many borrowers will be unable to meet their debt obligations. The combination of reduced deposits and increased non-performing loans will create severe liquidity problems, reduced income (less funds are available to lend), and increased operating costs for the financial institution. In extreme cases, it may even threaten the institution's solvency. Recognizing the potential for drought to severely damage its business, the financial institution will respond by rationing credit and/or increasing interest rates for households and businesses perceived to be highly exposed to drought.

Ray (1998) provides a simple model of how loan default risk affects interest rates. Assume a lender's expected profit π is

(4) $$\pi = L\big(p(1+i) - (1+r)\big)$$

were p is the probability of non-default (thus, $1 - p$ is the probability of default) that is the same for all loans, i is the interest rate charged to borrowers, r is the lender's opportunity cost of funds used for loans, and *L* is the amount of funds loaned. In a perfectly competitive market, profits would equal zero in equilibrium so

(5) $$i = \frac{1+r}{p} - 1 .$$

Now suppose that the lender's cost of funds *r* is 10%. If the probability of default is zero (p = 1) then the interest rate charged to borrowers is also 10%. However, if the probability of default is 10% (p = 0.9) then the interest rate charged to borrowers would more than double to 22%. Keep in mind that for areas exposed to extreme weather risk, the actual default rate would not be 10% each year. Instead it would be quite small in years when extreme events do not occur. But when the extreme event occurs, the default rate will be quite high, perhaps approaching 50% or higher.

Beyond the increased default risk of individual borrowers, the lender's cost of managing correlated risk is also passed on to borrowers. These increased costs occur because strategies traditionally used to manage uncorrelated risks are not effective for correlated risks. For example, the law of large numbers allows lenders to manage uncorrelated risks through diversification (i.e., reducing the concentration of the portfolio by loaning to many clients). However, diversification is much less effective in reducing the exposure of a lender to a correlated risk. As an illustrative example adapted from Katchova and Barry (2005), consider a loan portfolio comprising *n* identical households exposed to an uncorrelated risk (e.g., death of the borrower) and a correlated risk (e.g., drought). As a result of correlated risk, interest rates will also include the cost of managing the correlated risk in the credit portfolio associated with the loan. Thus, the lender's profit equation becomes

(6) $$\pi = L\big(p(1+i) - (1+r+c)\big)$$

where $c \geq 0$ represents the cost of managing correlated risk.[2] Interest rates would now be calculated as

(7) $$i = \frac{(1+r+c)}{p} - 1 .$$

The lender's cost of managing correlated risk becomes imbedded in the calculation, further increasing interest rates.

Finally, note that this simple example assumes a competitive market for loans. In rural areas of lower income countries, there are often very few formal lenders and sometimes, very few informal lenders. This lack of competition can cause market interest rates to be even higher relative to the lender's opportunity cost of capital.

In this way, weather and other natural disaster risks directly affect local credit markets. Credit constraints and higher costs of borrowing reduce rates of asset accumulation for smallholder agricultural producers and the businesses that provide services to them, thus retarding economic growth and perpetuating poverty.

While the effective use of credit can increase the trajectory of asset accumulation, borrowing also increases risk. Debt service is a fixed cost that must be paid regardless of realized income

[2]As an example, this cost could be excess reserves held by the bank. This cost is represented as a multiplicative scalar because these costs are likely to increase for larger loans that increase the concentration of the portfolio and create larger risk for the portfolio when borrowers default.

and regardless of whether the assets purchased with credit are still productive or have been destroyed due to some unforeseen event such as a catastrophic weather disaster (e.g., higher yielding crop varieties and inputs purchased with credit and destroyed by drought). Reduced income or asset losses caused by a negative shock could saddle the household or business with large debts in the foreseeable future. Thus, in areas prone to extreme weather events or other natural disasters, risk-averse households and businesses may be reluctant to use credit even when it is available.

1.4 Market Access

While our focus is on access to credit markets, similar opportunities to increase net income and thus, the rate of asset accumulation can result from improved access to other types of markets. New or expanded output markets provide opportunities to increase sales. New or expanded input markets provide greater choices of inputs and more competitive prices. Improved access to labor markets increases employment opportunities for rural households. Of course, the converse is also true: reduced market access tends to reduce rates of asset accumulation.

Households and businesses located in rural areas of lower income countries are generally handicapped by a lack of access to well-developed, spatially integrated output and input markets. There are many reasons why markets fail to develop but in rural areas of many lower income countries, catastrophic weather risk is an important constraint on market development. The business that enterprises need to provide input and output markets for other businesses can fail to emerge because of catastrophic risk exposure and the credit constraints also caused by catastrophic risk. As a hypothetical example, agricultural export markets may fail to develop in a region because wholesalers (the firms to whom an exporter might sell) do not want to experience a shock to supply caused by an extreme weather event.

1.5 Insurance and Asset Accumulation

Appropriate insurance products can facilitate asset accumulation in rural areas of lower income countries. In the most direct sense, insurance can provide at least partial compensation to households and businesses that lose income and/or assets due to negative shocks such as extreme weather events. For example, agricultural insurance products can protect farmers against reduced income due to crop losses. Similarly, insurance that covers the consequential losses and extra costs that result from extreme weather events can protect businesses against reduced income and business disruptions. Various types of assets (including human assets) can also be insured against loss. Thus, insurance can facilitate asset accumulation by directly protecting against loss to income and/or assets.

Insurance availability can also indirectly facilitate asset accumulation. Creditors will offer more credit and/or better credit terms to borrowers who are insured against income and/or asset losses. In some cases it may be possible for creditors to insure themselves against consequential losses (reduced income and/or increased expenses) that result from extreme weather events. To the extent that insurance purchasing makes creditors more resilient, more credit will be available in the affected area both before and after an extreme event.

Insurance availability can also indirectly facilitate asset accumulation by improving the resiliency of other businesses that provide valuable market services. The resiliency of households and businesses to extreme weather events is inextricably tied to the resiliency of the other businesses with which they interact, purchasing inputs and selling outputs. Likewise, the resiliency of any business is tied to the resiliency of upstream and downstream firms in the value chain.

Households and businesses often engage in low-risk, low-return productive activities in an effort to protect limited assets from loss. The implicit risk premium from these decisions can be extremely high (Zimmerman and Carter, 2003; Morduch, 1995). For example, Rosenzweig and Binswanger (1993) find that in the semi-arid tropics of India, poor farmers who engaged in low-risk activities to reduce their exposure to rainfall variability were giving up as much as 35 percent of potential annual profits. If effective insurance could be purchased at a comparatively lower risk premium, households and businesses could switch to productive activities that promise higher rates of return thus also creating the potential for higher rates of asset accumulation.

Section 2 Considerations of Scalability and Sustainability

If index insurance is to contribute to long-run economic growth and poverty reduction, it must be both scalable and sustainable — a specific index insurance product expands beyond a small-scale pilot and matures to a widespread, self-sustaining program. Scalability and sustainability have also been applied to the general concept of index insurance, suggesting it is an innovation that can facilitate weather risk transfer on a global scale.

For commercially sold index insurance, the concepts of scalability and sustainability are interrelated. An insurance product that does not exhibit the potential for sustainability will never be scaled up, as the insurer's interest will last only to the extent that the product elicits commercially sustainable demand. Similarly, an insurance product will not last long in the marketplace (it will not be sustainable) if it does not exhibit the potential for achieving sufficient market volume so that economies of scale can be realized.

2.1 Scalability

Development professionals often talk about whether it is possible to scale up particular interventions. In this sense, "scale up" is used in a manner that is largely interchangeably with "massification" — a term borrowed from business management to describe a process where a product or service is (re)designed and made available to a broader market. A new development intervention or a new market-based product or service is said to be "scalable" or have "scalability" if it can, in principle, be replicated or transferred to a new environment with little need for additional investment in research and development. In the context of index insurance, scalability implies the potential to transform a small-scale pilot into a larger program or the potential for widespread marketing of a particular index insurance product by a private insurer. Either way, scalability implies that the product has the potential to reach a broader target market.

From the perspective of an insurance supplier, achieving scale refers mainly to market volume measured either in terms of the sum insured or the premium sufficient to support the commercial viability of an insurance product. This obviously depends on having a product design that creates value for a large number of customers. Similarly, development professionals tend to think of scale in terms of identifying "what works" in technical assistance interventions. Both concepts are relevant when thinking about the scalability of index insurance products targeted to rural areas of lower income countries. However, asking "why" a particular strategy works may be more informative as it is the interaction of both the environment, broadly speaking, and the intervention mechanisms that produce results, and it is useful to be able to distinguish between the two effects (Pawson and Tilley, 1997). Understanding why a particular index insurance intervention works is best achieved when enquiry is informed by an underlying causal model of the processes that can be generalized to different contexts (Deaton, 2010).

2.2 Sustainability

Sustainable insurance products have long-run viability in commercial markets. For an insurance product to be sustainable there must be effective demand for the risk transfer provided by the product and the insurer must be able to supply the product at a price that creates value for policyholders and profit for the insurer.

Sustainability has multiple dimensions. Here we focus on financial viability, operational capacity, and the legal and regulatory environment. These dimensions of sustainability are influenced by the product design, market conditions, government policy, and the legal and regulatory setting.

Financially sustainable commercial insurance products have a premium sufficient to cover all costs, while also providing a return on investment competitive with alternative investments that carry a similar level of risk. The costs of supplying insurance can be divided into two categories: pure premium and operational costs. Pure premium is the expected payments that will be made to policyholders. It is typically described as the expected payments per dollar of sum insured — the pure premium rate. For example, if the insurer expects to make $5,000 in payments for every $100,000 of sum insured, the pure premium rate is 5 percent. Operational costs include all of the expenses that the insurer incurs to supply the insurance product to the market. Examples include the costs of obtaining contingent capital (i.e., reinsurance); marketing, sales and delivery; management, data collection and processing; accounting; legal services; and claims adjustment.

If the pure premium for a particular insurance product is 5 percent of sum insured and the operational costs are 7 percent of sum insured, then the breakeven premium rate (the premium rate that generates zero return to equity) is 12 percent. On top of this, the investors of the insurance company will expect some return on equity from their investment. If the return on equity adds 1 percent of sum insured to the premium (we assume that as a result of purchasing reinsurance the insurance company has only limited capital at risk), the total premium would be 13 percent.

In this example, we assume that operational costs as a percentage of sum insured are the same for every policy sold; however, this is often not the case. Many operational costs have a fixed component. For example, there is often little difference in sales and delivery costs for a small insurance policy and a large insurance policy. The same is generally true for data processing, accounting, and claims adjustment costs. This implies that as a percentage of the sum insured, the operational costs of small insurance policies are higher than those of large insurance policies — so breakeven premium rates are higher for smaller policies. This is a difficult challenge for the financial sustainability of insurance products targeted to smallholder households or small businesses that tend to purchase small-valued policies. Higher operational costs imply that commercial insurers must charge higher premium rates to smallholders, or else accept lower rates of return on equity. The challenge is even greater for microinsurance products targeted to rural areas, since in many lower income countries poor transportation and communications infrastructure greatly increase the costs of selling and servicing insurance.

Firms in the value chain and other risk aggregators, on the other hand, tend to purchase higher-valued policies that are operationally less costly (as a percentage of sum insured) relative to products targeted to smallholders. Clearly, product design has important implications for financial sustainability of index insurance products in that the target market — risk aggregators vs. households — may determine whether an index insurance product can be sustained and achieve scale in the long run.

In lower income countries, index insurance products are typically developed with donor-funded research and development support. Operational sustainability refers to the capacity of local stakeholders (insurers, weather bureaus, etc.) to maintain service with limited intervention after external start-up and technical support has been withdrawn. Achieving operational sustainability is not simple as it depends upon the capacity and commitment of the local insurance market. Operational sustainability also involves the ability of stakeholders to refine and modify the products in response to changes in the market or the risk environment. These factors are critical and justify investments in education and capacity building as products are developed and implemented.

Sustainability also depends on an enabling legal and regulatory environment to support the development and maintenance of weather index insurance products. Developers of weather index insurance products often focus most of their attention on the data analysis and risk modeling required for product design and pricing. While these factors are important, factors such as the types of insurance products authorized under the country's insurance law, the enforcement and supervision policies of the insurance regulator, and mechanisms for contract enforcement are also critical to the sustainability of any insurance product. For an innovation such as weather index insurance, creating such an enabling environment typically requires significant investments in building the capacity of key legal and regulatory stakeholders such as legislators and insurance regulators.

2.3 Common Challenges for Scalability and Sustainability

Practitioners developing index insurance products targeted to rural areas of lower income countries face many challenges. This section describes common scalability and sustainability constraints as a prelude to subsequent recommendations of how best to address them.

2.3.1 Products are Not Easily Replicable

In contrast to other pro-poor financial innovations such as microfinance, weather index insurance is not easily replicable. This is not always apparent. To reduce transaction costs and uncertainty associated with product development, attempts have been made to create standardized contracts that can be extended to different settings. One such effort was the World Bank Commodity Risk Management Group drought index insurance contract for maize and groundnut production tied to credit for improved inputs and aimed at smallholder farmers (Osgood et al., 2007). The insurance was first piloted in Malawi, with hopes of extending the product to Kenya and Tanzania.

Although initial results appeared promising, operational difficulties changed the course of the pilot in Malawi. Due to loan recovery issues, the pilot transitioned from maize and groundnuts to tobacco — a high-value commodity with a strong supply chain and a reliable mechanism for loan repayment. Since tobacco production is sensitive to both drought and excess rainfall, the insurance contract had to be modified to cover both risks. Additionally, the product shifted from the micro-level (smallholder farmers) to the risk aggregator level (tobacco processing/trading company). In Kenya, in addition to the need to change the contract structure to better reflect the relationship between the local climate and the crop (a prolonged growing season for maize required a three-phase contract), uncertainties as to whether drought represented the dominant risk for farmers blocked the way forward. In Tanzania, operational difficulties (complications with coordinating participation of partner institutions) necessitated a “dry run,” which never reached a full pilot stage. This example clearly illustrates the difficulties of scaling up index insurance using standardized contracts. Even apparently homogeneous settings require a more complex strategy, given all the operational challenges encountered in the field.

Although some aspects of product design may be transferable such as common elements of insurance contract language, marketing strategies, or possibly delivery mechanisms, an off-the-shelf product that can easily be transplanted to diverse settings is unlikely to emerge. Rather, weather index insurance must grow out of the local context. When designing a weather index insurance product, practitioners must 1) recognize geographical differences in household and business production activities, weather risk vulnerabilities, and the availability of weather and loss data. It must identify and address catastrophic weather risk transfer needs without “crowding out” existing risk transfer mechanisms; 2) be innovative, but also recognize the bounds imposed by local market institutions and legal and regulatory constraints. To summarize, scalable and sustainable products must be designed in a manner responsive to a host of geographically heterogeneous meteorological, cultural, political, legal, regulatory, economic, and institutional factors.

2.3.2 Data Limitations

Limited data availability, common in lower income countries, poses significant challenges to developers of weather index insurance products. In particular, historical data tend to consist of samples too small to be statistically relevant, while data-generating infrastructure is often too sparse to produce adequate local measurements. These data limitations create difficulties with pricing the insurance product and measuring basis risk.

Historical data on the frequency and severity of the underlying weather risk are necessary to determine the pure premium rate for a weather index insurance product. These data are used to estimate the parameters of the probability distribution for the underlying weather risk. In practice, however, sufficient data to estimate the parameters of the probability distribution are frequently not available. A commonly used rule of thumb in statistical analysis is that a sample size of at least 30 observations is required to estimate the central tendency (mean) and variance of a probability distribution. Catastrophic insurance products are designed for low-frequency, high-severity events, however, which occur in the tail of the probability distribution. In a sample of 30 years, such an extreme event may have taken place only once. But does this mean that the probability of that event occurring again is 1 in 30? Perhaps the available 30 years of data represent an unusually auspicious period and the real probability of an extreme event is 1-in-10 years. Or perhaps the real probability of the extreme event is only 1-in-80 years and just happened to occur during the 30-year period for which data are available. Accurately estimating the tail of the distribution requires extensive historical data (ideally hundreds of years) but in lower income countries it is not common to have access to even 30 years of high-quality weather data, much less more. Qualitative data and the expert judgment of local stakeholders can compensate to some degree for limited quantitative data (Collier, Barnett, and Skees, 2010). Ultimately, however, practitioners working with limited information are faced with an imperfect understanding of the underlying scientific processes that generate the data. Insurers respond to this ambiguity by adding loads into their estimation of the pure premium rate.

Basis risk — loss of the policyholder is less than perfectly correlated with the underlying index — is a well known limitation of index insurance and is an obstacle to successful product scale up. Basis risk arises from the very feature that makes index insurance so effective in the first place. Using an exogenous index rather than actual losses to determine payments eliminates high transaction costs that make traditional insurance unaffordable. Given that basis risk is an inherent feature of any index insurance program, potential policyholders must be made aware of the risks the insurance product does and does not cover and thus have reasonable expectations of the product.

Product designers would like to have sufficient quantitative data to estimate basis risk using statistical methods. However, historical loss data are exceedingly uncommon. To assess how the underlying index is likely to map onto realized losses, designers must compensate for the scarcity of quantitative data with qualitative information. Care must be taken, however, to generate qualitative data in a rigorous and systematic fashion.

2.3.3 Basis Risk, Transaction Costs, and Product Design

Determining which type of product has the greatest likelihood to be sustainable in the long run is largely a balancing act between transaction costs and data needs for keeping basis risk in check. Products that require geographically precise measurements, and therefore dense data systems infrastructure, will also experience significant basis risk if this infrastructure is not in place. Designing index insurance against drought in a region characterized by varied microclimates, for example, requires individual weather stations and offering separate products for every microclimate location, which can be prohibitively expensive. Because capturing uncorrelated, idiosyncratic risk requires large information infrastructure outlays, index insurance is best suited for insuring against spatially correlated weather events.

Choosing the target market for index insurance involves a similar tradeoff between transaction costs and basis risk. Basis risk tends to be higher for household products that require point-specific assessments than for risk aggregator products that require assessments at a community or regional level. Combining the estimation of several data sources (e.g., weather stations) tends to lower estimation error of the weather event more than using a single data source (Ali, Lebel, and Amani, 2005). Few lower income countries will have data systems sufficient to support the development of scalable household products. Because data systems infrastructure is vastly underdeveloped in many lower income countries, risk aggregator products are likely the only feasible mechanism for extending weather index insurance into these regions.

2.3.4 Lack of Index Insurance Experience

Individuals inhabiting rural areas of lower income countries often have little experience with any type of insurance product (and even less with index insurance) and little knowledge of insurance providers. Being risk averse (as they must be if they are interested in purchasing fully priced insurance), households are often understandably concerned about the counterparty risk involved with paying a premium in the present in exchange for a large payment at a specified future time period should some defined extreme weather event occur. Even householders who have some knowledge of insurance are likely familiar only with traditional loss-based insurance products such as automobile collision insurance and any effort to introduce them to index insurance products must be accompanied by extensive education. Thus, an initial target market for weather index insurance products is likely to be risk aggregating businesses that generally have more familiarity with insurance products and providers.

Local insurance providers also typically lack experience with index insurance products and require careful capacity building efforts in order to ensure a product's scalability and sustainability. While employees of these firms understand basic insurance principles, their understanding is grounded in the traditional loss-based products currently being offered. That frame of reference can make it difficult for them to understand the unique characteristics of index insurance.

Government policy makers and insurance regulators are also likely to be unfamiliar with index insurance. Laws that authorize insurance markets vary widely across jurisdictions so it is difficult to generalize about legal issues that may be encountered when introducing weather index insurance to a region. Index insurance products can take on different legal and regulatory classifications depending on factors such as the delivery mechanism and the nature of the policyholder's insurable interest. It is critically important to:

- Ensure the index insurance product being developed fits into a classification that is authorized under law and recognized by regulatory authorities. In some cases, existing laws may need to be amended to authorize the sale of index insurance products;
- Obtain legal counsel from someone who is familiar with the local legal and regulatory environment as well as someone who is familiar with insurance laws in other jurisdictions; and
- Obtain regulatory approval for any specific index insurance product if it is determined that the proposed index insurance product can be categorized so that it is authorized under law. Obtaining such approval is essential if the product is to be scalable and sustainable.

Initiating discussions with the insurance regulator is not something that can wait until after the product is developed; rather, it is an early and integral part of the product development process. Unless the regulator has had previous experience with index insurance products, this will likely require a significant capacity building effort.

2.3.5 Determining Appropriate Delivery Channel

The delivery or distribution channel is the component of product design that determines how the insurance company reaches its clients. Delivery includes not only sales but also customer service. The delivery channel handles the purchase agreement, transfer of premiums, transfer of insurance payouts, and ongoing customer care. Educating the target market about the insurance product is distinct from delivery channel functions and may be carried out by different stakeholders; however, education and delivery are complementary activities and should be carefully coordinated.

Costs and inefficiencies in product delivery can impede the performance and affordability of the product. In lower income markets, having efficient delivery channels is particularly important due to small market volume and the pressure to minimize transaction costs to maintain as low a premium as possible for the client. Finding an effective and cost-efficient delivery channel can be particularly challenging for insurance products targeted to households.

A central theme of delivery is the strong positive relationship between client contact and transaction costs. Client contact creates additional opportunities for customer training and may increase the probability that the insurance is used effectively (e.g., an appropriate sum insured is purchased). Yet client contact increases transaction costs and thus the cost of the insurance.

Therefore, insurers must navigate the tradeoff between providing personalized customer care and low transaction costs.

At one end of the spectrum is the traditional insurance agent delivery channel in which a representative of the insurance company visits each potential client. This is a model with high client contact and high transaction costs. One benefit of this model is that the person selling the insurance has had specialized training, and ideally, can help clients assess their exposure, answer any questions about the insurance, and provide a mechanism through which the client could contact the insurer directly if needed. When households are located in remote or difficult to reach areas, the transaction costs of an insurance agent model become too high for the small sums insured. Thus, it is unlikely for traditional agent insurance models to be feasible in many regions of the world. On the other hand, in the case of risk aggregators, a traditional insurance agent model may be more viable as the sum insured is likely to be higher for households.

At the other end of the spectrum is a delivery channel with low client contact and low transaction costs. Examples include automated services such as automatic teller machines (ATMs) or cell phones. In recent years, automated service technologies have greatly advanced in many lower income countries and have been used to increase access to banking services. Such technologies could, in principle, deliver index insurance as well. Clients would receive some initial training regarding the insurance product and all transactions would be handled through the automated service. Using automated services is likely most feasible where index insurance sales could "piggyback" on the existing automated services of a local financial institution.

An in-between model is face-to-face (rather than automated) delivery through some intermediary with whom the potential client already has a relationship, such as a financial institution or an input supplier. This delivery channel is less costly than the traditional insurance agent model since it utilizes existing distribution networks but likely more expensive than delivery via automated services. For this in-between model, the delivery cost will likely include some commission that compensates the intermediary (e.g., a bank) for the use of its facilities and personnel. A significant drawback to this approach (especially in the early stages of an insurance market) is that the insurance sales are a supplementary transaction to the primary reason the client is visiting the intermediary (e.g., for a loan). As a result, the person selling the insurance tends to be specialized in a field other than insurance sales and, therefore, may be less equipped to assist the potential client in the purchase decision.

Working through an intermediary may be particularly helpful if increasing access to the services of that intermediary is a goal of the index insurance project. For example, if increasing a households' access to credit is the goal, then it may be logical to use a bank as an intermediary for delivering the insurance product. The index insurance can even be linked to the other services provided by the intermediary in a way that recognizes the risk reduction created by the insurance. For example, a bank could provide a lower interest rate on a loan to households that purchase the index insurance. However, project developers would do well to consider possible unintended consequences of any such arrangement before committing to this type of linkage. As an example, if clients receive a preferential interest rate when they buy the insurance to cover the outstanding value of their loan, they may be tempted to purchase a minimum insurance value to receive this additional benefit, without necessarily recognizing the broader context in which the insurance has value. This additional incentive could distract households from making a purchasing decision based on their actual risk exposure.

Deciding on an appropriate delivery channel must be evaluated in the larger context of product design and market development. Market characteristics, such as the capacity of the insurance provider and the use of automated services among the target market, influence what is feasible and most suitable for achieving the desired objectives. These considerations apply primarily to household products where there is greater need for highly efficient delivery mechanisms. Clearly, the legal and regulatory framework must also be considered to identify what types of delivery models are permissible.

2.3.6 Limited Demand

Generally speaking, household demand for insurance against catastrophic natural risks is low. People tend to underestimate the likelihood of a catastrophic event and thus are likely to undervalue the insurance (Kunreuther, 1996, 1976; Kunreuther and Slovic, 1978; Tversky and Kahneman, 1973). In lower income countries, demand is further reduced by limited household resources and the common perception that there should be a return on premium paid. Given other immediate needs, the opportunity cost of funds used for an insurance premium is very high. For example, low uptake of an index-based flood insurance product in Indonesia was attributed to low consumer demand for a product that insures only the less frequent catastrophic levels of flooding (Chong, 2009). Similarly, experiences with weather index insurance products being offered in India seem to confirm the notion that households have little demand for catastrophic insurance coverage (Giné, Townsend, and Vickery, 2008).

As noted earlier, when pricing insurance products that protect against low-frequency, catastrophic events, insurers compensate for limited data by adding an ambiguity load to their estimate of the pure premium rate. This, combined with generally low household demand for such insurance coverage, can create a wedge between the price that insurance providers are willing to accept and the price that households are willing to pay. This price wedge may diminish over time if potential buyers are educated about their catastrophic risk exposure. Also, ambiguity loads may be reduced over time as insurance providers obtain more experience with the insurance product. Nevertheless, these various factors that limit demand for catastrophic insurance can be a significant challenge for scalability and sustainability.

Risk aggregating firms rather than households may be in a better position to assess their exposure to catastrophic risks as firms tend to collect more data to analyze their income, assets, liabilities, etc., and thus have a more complete framework for quantifying losses. Some firms may even have these records from a previous catastrophic weather event, which can be used as a starting point for assessing their exposure. Also, businesses may have greater access to capital and thus a lower opportunity cost for funds invested in insurance premiums. This is yet another reason that initial offerings of weather index insurance are likely better targeted to risk aggregators than to households.

2.3.7 Premium Subsidies

Some donor-funded projects have used premium subsidies to increase demand for new index insurance products. Typically, these subsidies are rationalized by arguing that they support development objectives and will last for only a few years until consumers have become accustomed to purchasing the products. The use of premium subsidies has been further encouraged by a recent trend toward designing index insurance products to protect against moderate losses (i.e., products that pay as frequently as 1 in 3 or 1 in 5 years). One reason for doing this is to address the cognitive failure problem in assessing low-probability, high-consequence events, and thus stimulate demand. However, when index insurance is designed to protect against increasingly moderate losses, the price of the insurance is higher compared to a catastrophic policy. As a result of the higher price, product designers may be compelled to seek higher levels of premium subsidy.

There are a number of concerns with insuring against moderate losses and offering premium subsidies. First, that catastrophic weather events are often more spatially covariate than moderate weather events implies that basis risk will be more problematic when insuring against moderate losses. Second, insurance is a rather expensive financial instrument designed to protect against low-probability, extreme losses — savings and credit are generally more economically efficient mechanisms for managing small to moderate losses. Third, while the intentions may be good, premium subsidies create several problems. Risk that is accurately priced provides information for economic agents on which to base activity decisions, such as whether it is valuable to invest in risk mitigation, to expand activity, or exit. Since premium subsidies lower the cost of the insurance, policyholders do not receive accurate price signals regarding the magnitude of their actual risk exposure and thus, make economically inefficient decisions. When premium subsidies are eventually removed, demand for these insurance products tends to collapse. Premium subsidies also distort markets by "crowding out" alternative risk transfer or risk mitigation strategies. In addition, premium subsidies make it difficult to assess scalability and sustainability. Donors may be willing to fund premium subsidies for small pilot projects but are not likely to be willing to provide the large amounts of funding required to subsidize scaled-up insurance programs — and to do so on a continual basis. Perhaps the greatest concern is that promoting premium subsidies sets a precedent difficult to reverse and threatens the commercial viability of index insurance before the nascent concept is even put to a true market test. For these reasons, anyone who is seriously concerned about scalability, sustainability, and economic efficiency must question the use of premium subsidies for weather index insurance products.

In contrast, there is widespread agreement that an efficient use of donor funding — risk assessments, feasibility studies, product development, capacity building, and other start-up costs is necessary and beneficial because:

- Insurance providers are unlikely to invest in these substantial start-up costs. Once an index insurance product is developed for a particular location it can easily be copied by competitors in that region who have not had to incur any of the start-up costs. As a result, insurance providers are unwilling to make these investments; and
- Index insurance can "crowd in" other market-based risk transfer instruments. Index insurance is used to transfer the economic consequences of the most catastrophic, spatially covariate weather risk out of the local area. With that risk removed, opportunities for other market-based risk transfer instruments are created that can protect against residual risks far less catastrophic and spatially covariate.

Section 3 Recommendations

In this section, we present our recommendations related to the process of developing weather index insurance and recommendations for product design. These recommendations are based on: 1) the relationships between risk, credit availability, asset accumulation, and economic growth; 2) the recognized scalability and sustainability challenges; and 3) our experiences developing and implementing index insurance programs in lower income countries. We recognize that practitioners who have also made significant contributions to these activities may not agree with all of our recommendations and that unique conditions may motivate practitioners to deviate from these recommendations. Nevertheless, our recommendations are based on what we believe to be the current state of knowledge and are offered in the hope they prove useful to researchers and practitioners.

3.1 Process Recommendations

We have four primary recommendations regarding the process of developing index insurance products. In practice, some of these recommendations can be difficult to implement and are likely to slow down the work of developing weather index insurance products, however — we are convinced that they are critical to eventually creating a scalable and sustainable index insurance market.

3.1.1 Focus on Legal and Regulatory Issues from the Start

Legal and regulatory issues are almost certainly the most overlooked aspect of weather index insurance product development. While aspects such as selecting an index, identifying an appropriate delivery mechanism, educating the target market, obtaining reinsurance, and constructing a pilot test of the proposed product are critically important, a product can never scale up beyond the pilot stage and will never be sustainable without an enabling legal and regulatory environment that adheres to international standards and practices for insurance. This becomes even more challenging for index insurance as there are currently no international standards; rather this is being done on a case-by-case basis with some reference to other pilot projects.

Given the lack of experience with index insurance in most lower income countries, obtaining the legal authority to offer index insurance as a commercial insurance product and working with the insurance regulator to establish appropriate regulations and consumer protections can be a long and arduous task — but absolutely critical. It is far more pragmatic to postpone this difficult task until a pilot test has proven that a commercial product may be feasible. We believe that there are many reasons why this is inadvisable. It may be that the insurance product sold during the pilot test has characteristics that local legal and regulatory authorities will never allow for a commercial product. Even if the local authorities are willing to facilitate the development of index insurance markets, it may take several years before the legal and regulatory prerequisites for a commercial index insurance product can be put in place. If this process begins only after a pilot test has been conducted, the delay in scaling up may cause donors and local stakeholders to lose interest. In addition, expanding the pilot during this period may be perceived by local legal and regulatory authorities as an effort to circumvent their authority. More importantly, by not engaging these authorities from the very beginning of the process, product developers miss out on valuable opportunities for helping build the local capacity needed to maintain a sustainable index insurance market.

It is not surprising that this aspect of product development is often overlooked. It is difficult and occasionally trying work. It is highly likely that potential donors will be dissuaded by the challenges inherent in working with local policymakers and government officials or by the time required to obtain necessary approvals. However, if one is seriously concerned about building scalable and sustainable index insurance markets, it is an important step that cannot be avoided and should not be postponed.

3.1.2 Replicate Processes not Products

Weather index insurance products cannot be easily replicated. They must be developed in a manner that responds to a host of geographically heterogeneous meteorological, cultural, political, legal, regulatory, economic, and institutional factors. Some aspects of product design may be applicable in multiple locations but a prototype insurance product that can be replicated as a whole across a variety of different local contexts is neither likely nor desirable.

What can be replicated is an effective process for developing index insurance products. In fact, we believe that product development and implementation should be informed by a model that emphasizes critical steps in the process. New products are developed by repeating the steps in the process rather than by simply replicating a previously developed product.

The implication of this is that large start-up costs for developing new weather index insurance products cannot be avoided. Incurring these costs is necessary both for designing products appropriate for the local context and for building the local capacity necessary to ensure that the product effectively transitions from external facilitators to local implementers. Investments in building market foundations and strong local capacity will reduce the start-up costs of future index insurance ventures in a given region.

3.1.3 Subsidize Start-Up Costs and the Market Failure Layer, not Premiums

Donor funding of risk assessments, feasibility studies, capacity building, and other start-up costs is necessary for the development of weather index insurance markets. These are all public goods unlikely to be funded by local insurance providers. This is true even of product development because once investments have been made to create a product appropriate to the local context, the product can easily be copied by other insurance providers in the area. Donor funding of start-up costs for index insurance can also “crowd in” markets for other risk transfer instruments. With an index insurance product transferring the catastrophic, spatially covariate weather risk out of the region, opportunities are created for other market-based risk transfer instruments that can protect against residual risks less severe and widespread.

Premium subsidies, on the other hand, can “crowd out” other risk mitigation or risk transfer mechanisms. They also create a dependency on continual subsidies that is incompatible with an objective of creating scalable and sustainable index insurance markets. The dependency created by insurance premium subsidies has been consistently demonstrated by experience with products such as crop insurance and flood insurance in both developed and developing countries across the globe.

Supporters of premium subsidies for weather index insurance often employ reasoning that is vaguely reminiscent of the "infant industries" rationale for protecting domestic industries from the rigors of a globally competitive market. They argue that the subsidies are only for a short time — a way to "prime the pump" until the market can mature and develop into a fully competitive market. But just like those infant industries, most subsidized insurance markets never quite seem to mature to the point where they are ready to give up their privileged status. Insurance providers and policyholders become intent on maintaining access to the economic rents that can be derived from the premium subsidies. When donors are no longer willing to support premiums, the local government is pressured to provide the subsidies. If government is unable or unwilling to assume the financial burden of providing premium subsidies, the market is likely to collapse.

In addition to funding start-up costs, the least distorting subsidy is through risk layering — clearly delineating the layer of risk that can be transferred commercially through insurance from the market failure layer that is characterized by cognitive failure and ambiguity loading (Barnett, Barrett, and Skees, 2008). The government premium subsidy would then be justified on social grounds and only be applied to the market failure layer. We have successfully tested such risk layering in the World Bank funded project, Index-based Livestock Insurance, in Mongolia (2006). The commercial product pays for losses between 6 percent and 30 percent of the county livestock mortality rate. The government of Mongolia pays for losses beyond 30 percent which are quite rare. Losses beyond 30 percent mortality are financed through a contingent loan from the World Bank. Should the government decide that it is too expensive to support the program and exits, the commercial layer of risk will remain without major disruptions to the program (Mahul and Skees, 2007).

3.1.4 Assess Impacts

In lower income countries, the development of weather index insurance markets is a means to an end. The ultimate goal and measure of success is poverty reduction. Index insurance contributes to that goal by providing a mechanism for transferring the financial impacts of catastrophic, spatially covariate weather risks out of the local area. This risk transfer helps to protect accumulated assets and encourages investment in higher-risk, higher-return activities, in turn, stimulating further asset accumulation. The benefits to households may be direct when index insurance products are targeted to households. But given some of the difficulties in developing scalable and sustainable individual insurance products, the benefits to households of developing risk transfer markets may initially best be met through indirect means via risk aggregators. Risk aggregating firms (banks and microfinance entities, input suppliers, output processors, etc.) that use weather index insurance to transfer their exposure to extreme weather events are more likely to provide uninterrupted services to local households and businesses and potentially at better terms. The outcome will be greater capital flows into the region and more access to well-developed and spatially integrated markets — critical drivers for poverty reduction.

While these hypothesized relationships between weather index insurance and poverty reduction are based on sound economic reasoning, they are as of yet largely untested in this context with little accumulated evidence. Recently, many weather index insurance projects have been initiated but at this time, few of these projects develop beyond the pilot stage. Formal market-based weather risk transfer is but one of many possible interventions designed to address the constraints to poverty reduction. If donors are to judiciously allocate scarce development funds, they need some assessment of which intervention is likely to generate the greatest marginal contribution to poverty reduction per dollar spent. This certainly depends on the stage of development and the degree to which various institutional and physical infrastructures are present to support index insurance — the prerequisites for index insurance must be present.

In order to contribute to the body of evidence of index insurance effectiveness, it is important that each weather index insurance project contain a carefully conceived plan for assessing the eventual impacts on poverty reduction. These plans should be conceived as part of the overall project planning process. The type of impact assessment will depend on the scale of the project and considerations of assessment costs with available resources. Financial interventions pose special problems for evaluators that other types of interventions do not. Most importantly, the voluntary nature of insurance participation and the usually low participation rate require additional consideration and tailoring of an evaluation protocol. An extensive, heavily funded project will involve a more formalized evaluation agenda, perhaps including baseline surveying and panel data construction with the intention to empirically test a theoretical model of the development intervention, the implementation of a randomized trial, or observational study. A smaller project may rely more heavily on case study and other less expensive methods to assess outcomes of the intervention. All development projects must adequately document their activities from planning through implementation and adjustment, such as by maintaining an active Logical Framework that describes the process, expected outcomes, and basic performance indicators of a project.

Weather index insurance market development most certainly has a place in the range of tools used to reduce poverty. Many questions remain as to the relative effectiveness compared to other types of interventions as well as which approaches within the market development process are most likely to take hold and produce the intended benefits. These are empirical questions that can only be answered through carefully considered impact assessments that contribute meaningfully to the accumulated body of knowledge.

3.2 Product Recommendations

We have three recommendations regarding the features of weather index insurance products for developed in the future. Some of these recommendations challenge current approaches while others are not dissimilar to the conclusions being reached by other development practitioners.

3.2.1 Focus on Risk Aggregator Products First

Most weather index insurance products developed to date have been targeted to households. In contrast, our experience has led us to conclude that when introducing weather index insurance into a new market environment the focus should first be on products targeted to risk aggregators. Products for risk aggregators require assessment of a catastrophic weather event at a community or regional level, whereas household products require an assessment of the weather event at a specific geographic point. As a result, the risk aggregator product requires fewer data sources (e.g., fewer weather stations) than products for households. In fact, since weather station infrastructure is so underdeveloped in many lower income countries and satellite data are too coarse for many household risks (with a few notable exceptions), household products are simply inadvisable for many regions. Risk aggregator products are likely the only feasible mechanism for extending weather index insurance into rural areas of many lower income countries. Pursuing weather index insurance products for households despite inadequate data is likely to lead to 1) higher insurance prices by insurers and reinsurers due to uncertainty about the risk, and 2) products that poorly capture the risk of the target market and therefore contribute little to disaster risk management. As a result, risk aggregator products would seem to provide a better return on investment for economic development efforts.

Another important reason for focusing on risk aggregator products is that for households idiosyncratic risk tends to comprise the greatest portion of their overall risk exposure (Dercon, 2005; Morduch 2005). Consequently, basis risk for micro products may be unsustainably high, suggesting that other risk transfer mechanisms, such as informal risk pooling, may be better suited for managing idiosyncratic risk at the household level. Risk aggregators, on the other hand, may be in a better position to pool idiosyncratic risk, but remain particularly vulnerable to covariate risks, which makes them a more appropriate target for index insurance (Barnett, Barrett, and Skees, 2008).

An added benefit of working with risk aggregators is that they can generally be expected to engage in a risk management discussion in a more sophisticated way than households. The professional experiences of these firms seem to prepare them to understand weather index insurance more fully as they likely already use other financial contracts to manage risks. Relative to households, available data are more suitable to assess exposure to catastrophic risks for risk aggregators.

Some may question whether products designed for risk aggregators such as rural banks and agricultural value chain members substantially benefit the poor and would rather see insurance products that can be purchased by households. While there are certainly risk aggregating firms that will only work with better off households, many financial institutions, agricultural value chain members, etc., do work with poor populations. Moreover, one reason that some risk aggregating firms limit the services they provide to the poor is that they cannot manage the catastrophic weather risk associated with serving these clients. As we have considered this question ourselves, we return to the risk management axiom: when losses occur, someone must pay for them. For example, households may pay banks higher interest rates because the bank is unable to efficiently manage the catastrophic risk exposure in the region. Also, agricultural input suppliers, commodity processors, and lenders alike may limit their presence in regions where households are vulnerable to catastrophic risk because these risk aggregators are unable to manage this correlated risk themselves. Weather index insurance products for risk aggregators that enhance the ability of these firms to manage catastrophic risk can increase household access to the services of these firms. Increased access to credit, inputs that increase crop productivity, and commodity export markets have all been shown to have important developmental outcomes (World Bank, 2007) and are the ultimate goal of many development projects.

3.2.2 Think beyond Protecting against Yield Losses for a Single Crop

Most weather index insurance products developed to date have been designed to insure rural households against reduced yields for a single crop. This is not surprising given that much of the innovation that led to weather index insurance was motivated by problems with traditional crop insurance programs that focus on farm-level crop yields (Skees, Black, and Barnett, 1997; Martin, Barnett, and Coble, 2001). Such models were developed for higher income countries where many farmers specialize in specific crops and where data on crop yields and household income are abundant. Furthermore, the input packages used to grow crops in higher income countries are also significantly more homogenous than those used to grow crops in lower income countries.

While the relationship between yields of a specific crop and the well-being of the policyholder may be highly related for many farmers in developed countries where crop specialization has led to highly specialized farms, it is less clear that the yield of a specific crop is as important to households in developing countries. Most households in lower income countries do not rely solely on income generated by a single crop (World Bank, 2007). Instead, they plant a variety of crops and often have livelihood portfolios diversified across labor activities other than farming. For these reasons, weather insurance designed around yield variability for a single crop is not likely the best mechanism for protecting farm households.

In our experience, when households talk about financial impacts of weather-related disasters, the discussion extends well beyond reduced yields of a single crop. They talk about multiple causes of reduced income (e.g., reduced access to markets creates lower prices for outputs, jobs lost, reduced yields or quality on multiple crops, reduced livestock production) and increased expenses (e.g., reduced access to markets causes higher prices for inputs and consumption goods, increased disease and pest pressure, increased irrigation expense). But mostly, they talk about losses of assets (buildings destroyed, livestock lost, topsoil washed away, perennial crops destroyed, savings depleted, family members who have died or been injured). These households recognize that while a shock that reduces annual returns can slow their rate of economic growth, a shock that destroys assets can put them into a poverty trap.

The misplaced emphasis on yield losses for a single crop is obviously related to the misplaced emphasis on household products. Most risk aggregators clearly have weather risk exposure that extends well beyond their clients having reduced yields for a single crop. Thus, risk aggregator products are typically not designed around how extreme weather events affect a particular crop. They are more flexible and therefore, applicable to more heterogeneous purchasers.

3.2.3 Focus on Catastrophic Events

While developers of weather index insurance products have increasingly focused on insuring against moderate losses, the most effective and efficient use of weather index insurance is to protect against catastrophic events. The current focus on moderate losses is motivated by concerns that buyers with little or no previous experience with insurance will become discouraged and quit purchasing index insurance if they do not occasionally receive a payment. Again, the misplaced emphasis on household products has led to another problem — a misplaced emphasis on moderate losses.

Insurance — traditional, indemnity-based insurance as well as index insurance — is a relatively expensive risk management mechanism. For that reason, it should be used primarily to protect against low-probability, catastrophic risks difficult to manage using other means. It is almost always more economical to manage the financial consequences of more frequent but less devastating risks through savings, borrowing, diversification, risk mitigation, and various types of informal family and community reciprocity agreements.

Not only is insurance against moderate losses quite expensive, in the case of index insurance, we believe that it is likely to have higher basis risk. We hypothesize that the spatial covariance of many weather events increases with the severity of the event. For example, more severe droughts tend to be more widespread than less severe droughts. If this is true (research on this question is ongoing), it suggests that the spatial specificity of data required for developing index insurance that protects against moderate loss events is greater than that required for developing index insurance that protects against catastrophic, extreme loss events. Said differently, for any given spatial specificity of available weather data, the basis risk will be higher for index insurance that protects against moderate losses than for index insurance that protects against catastrophic losses.

It is also likely the case that the covariance of returns across different activities is greater for more extreme weather events. In other words, steps to diversify a portfolio by investing in several activities may be ineffective for protecting against extreme weather events. If so, this further supports our view that weather index insurance should focus primarily on addressing the range of consequential losses that result from catastrophic weather events.

Section 4 Conclusion

This document reviews relevant research and pilot experiments (including our own) regarding the potential role of index insurance in economic development. In particular, we believe that index insurance can aid in reducing poverty and increasingly economic development via products other than those targeted to households. We challenge others to consider how index insurance products fit into broader poverty reduction strategies and reassess how one creates scalable and sustainable index insurance products. Our recommendations reflect what we believe is the current state of knowledge regarding index insurance. We recognize that others may not agree with some of these recommendations and we welcome their feedback and comments. Our views have evolved. We are now challenging ideas that we previously promoted. It is our hope that the ideas put forth in this document contribute to an ongoing dialogue that motivates further research and improved practice by those who strive to reduce poverty in rural areas of lower income countries through the development of scalable and sustainable weather index insurance products.

References

Ali A., T. Lebel, and A. Amani. "Rainfall Estimation in the Sahel. Part I: Error Function." *Journal of Applied Meteorology* 44(2005): 1691–1706.

Armendáriz de Aghion, B., and J. Morduch. *The Economics of Microfinance.* Cambridge: The MIT Press, 2005.

Barnett, B. J., C. B. Barrett, and J. R. Skees. "Poverty Traps and Index-based Risk Transfer Products." *World Development* 36(2008): 1766–1785.

Besley T. "Nonmarket Institutions for Credit and Risk Sharing in Low-Income Countries." *Journal of Economic Perspectives* 9(1995): 115–127.

Chong, C. Y. "Tensions in the Microinsurance Sector — Observations From Munich Re's Experience in Indonesia." MicroCapital Story, June 29, 2009. Available at http: //www.microcapital.org/microcapital-story-tensions-in-the-microinsurance-sector-observations-from-munich-res-experience-in-indonesia/
Accessed April 30, 2010.

Collier, B., J. R. Skees, and B. J. Barnett. "State of Knowledge Report — Data Requirements for the Design of Weather Index Insurance." Report prepared for the Bill and Melinda Gates Foundation, Seattle, WA, June, 2010. Available at
http: //www.globalagrisk.com/Pubs/2010_GlobalAgRisk_State_of_Knowledge_Data_sept.pdf
Accessed September 6, 2010.

Collier, B., J. R. Skees, and B. J. Barnett. "Weather Index Insurance and Climate Change: Opportunities and Challenges in Lower Income Countries." *Geneva Papers on Risk and Insurance — Issues and Practice* 34(2009): 401–424.

Deaton, A. "Instruments, Randomization, and Learning about Development." *Journal of Economic Literature* 48(2010): 424–455.

Dercon, S., ed. *Insurance against Poverty.* Oxford: Oxford University Press, 2005.

Giné, X., R. Townsend, and J. I. Vickery. "Patterns of Rainfall Insurance Participation in Rural India." *World Bank Economic Review* 22(2008): 539–566.

Hazell, P. B. R., J. Anderson, N. Balzer, A. Hastrup Clemmensen, U. Hess, and F. Rispoli. *Potential for Scale and Sustainability in Weather Index Insurance for Agriculture and Rural Livelihoods*. Rome: International Fund for Agricultural Development and World Food Programme, 2010.

Hellmuth, M. E., D. E. Osgood, U. Hess, A. Moorhead, and H. Bhojwani, eds. *Climate and Society Issue 2: Index Insurance and Climate Risk: Prospects for Development and Disaster Management*. New York, NY: International Research Institute for Climate and Society, Columbia University, 2009.

Katchova, A., and Barry, P. "Credit Risk Models and Agricultural Lending." *American Journal of Agricultural Economics* 87(2005): 194–205.

Kunreuther, H. "Mitigating Disaster Losses through Insurance." *Journal of Risk and Uncertainty* 12(1996): 171–187.

Kunreuther, H. “Limited Knowledge and Insurance Protection.” *Public Policy* 24(1976): 227–261.

Kunreuther, H., and P. Slovic. “Economics, Psychology, and Protective Behavior.” *American Economic Review* 68(1978): 64–69.

Mahul, O., and J. R. Skees. “Managing Agricultural Risk at the Country Level: The Case of Index-based Livestock Insurance in Mongolia.” Policy Research Working Paper WPS4325, The World Bank, Washington, DC, August 1, 2007.

Martin, S. W., B. J. Barnett, and K. H. Coble. “Developing and Pricing Precipitation Insurance.” *Journal of Agricultural and Resource Economics* 26(2001): 261–274.

Mechler, R., J. Linnerooth-Bayer, and D. Peppiatt. “Microinsurance for Natural Disaster Risks? Insights from a ProVention/IIASA Research Initiative.” *Real Risk.* Nicklin, S., B. Cornwell, and S. Fairbrother, eds. Leicester, UK: Tudor Rose, 2006.

Morduch, J. “Income Smoothing and Consumption Smoothing.” *Journal of Economic Perspectives* 3(1995): 103–114.

Morduch J. "Consumption Smoothing across Space: Testing Theories of Risk-sharing in the ICRI-SAT Study Region of South India.” *Insurance against Poverty.* Dercon, S., ed. Oxford: Oxford University Press, 2005.

Osgood, D. E., M. McLaurin, M. Carriquiry, A. Mishra, F. Fiondella, J. Hansen, N. Peterson, and N. Ward. “Designing Weather Insurance Contracts for Farmers in Malawi, Tanzania, and Kenya.” Final report to the Commodity Risk Management Group (CRMG), World Bank, and the International Research Institute for Climate and Society (IRI), Columbia University, 2007.

Pawson, R., and N. Tilley. *Realistic Evaluation*. London and Thousand Oaks, CA: Sage Publications, 1997.

Ray, D. *Development Economics.* Princeton: Princeton University Press, 1998.

Rosenzweig, M.R., and H.P. Binswanger. "Wealth, Weather Risk and the Consumption and Profitability of Agricultural Investments.” *Economic Journal* 103(1993): 56–78.

Skees, J. R., J. R. Black, and B. J. Barnett. “Designing and Rating an Area Yield Crop Insurance Contract.” *American Journal of Agricultural Economics* 79(1997): 430–438.

Tversky, A., and D. Kahneman. “Availability: A Heuristic for Judging Frequency and Probability.” *Cognitive Psychology* 5(1973): 207–232.

World Bank. *World Development Report 2008: Agriculture for Development*. Washington, DC: The World Bank, 2007.

Zimmerman, F. J., and M.R. Carter. "Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints*.” Journal of Development Economics* 71(2003): 233–260.