Insuring Against Drought-Related Livestock Mortality: Piloting Index Based Livestock Insurance in Northern Kenya[1]

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Abstract

Climate related shocks are among the leading cause of production and efficiency losses in smallholder crop and livestock production in rural Africa, additionally distorting incentives to production. Consequently, the identification of tools to help manage the risks associated with climactic extremities is increasingly considered to be amongst the key pillars of any agenda to enhance agricultural growth and welfare in rural Africa. This paper describes the application of a promising innovation in insurance design – index-based insurance – that seeks to bring the benefits of formal insurance to help manage the weather-related risks faced by rural crop and livestock producers in low-income countries. In particular, the paper highlights the research and development agenda of a comprehensive effort to design commercially viable index-based livestock insurance aimed at protecting the pastoral populations of Northern Kenya from the considerable drought-related livestock mortality risk that they face. Detailing the conditions that make the pastoral economy in Northern Kenya an ideal candidate for the provision of index-based insurance products, the paper describes the contract design, defines its structure, and offers assessments of its performance. The paper also highlights analysis indicating high potential demand amongst the target clientele. With a market-mediated pilot set to be launched in Marsabit District in late 2009 or early 2010, the paper closes by detailing the some of the key challenges and issues that were necessary to consider in the implementation of an index insurance pilot in the prevailing context as well as the subsequent assessment of its welfare impact.

[1] The authors would like to thank helpful comments from the participants at the AGRA Conference on "Towards priority actions for market development for African farmers" in Nairobi in May 2009. This paper draws heavily from and summarizes from Chantarat et al. 2009a and Chantarat et al. 2009b which offer more technical analysis and contextual detail into contract design and ex-ante welfare and demand analysis respectively.

1. Introduction

Downside-production risk is a considerable constraint to agricultural production and development whose impact is particularly felt by small-holder farmers and livestock keepers whose meager resource base offers them with few effective options to manage this risk. As is true in most of rural Africa, thin markets, poor physical and institutional infrastructure and weak access to credit and savings markets compound the problem of production risk that poor farmers and livestock keepers face.

Climate extremities are the greatest source of agricultural production risk with droughts and floods resulting in total or partial crop failures as well as forage and water scarcity that reduce livestock productivity and, in severe cases, lead to widespread livestock losses (Thornton et al. 2008; Hellmuth et al. 2007; IPCC 2007). Over the past decade or so, natural disasters have risen sharply worldwide with the biggest increase in low-income countries whose disaster incidence rose at twice the global rate. Of these, drought and flooding impact more people worldwide than other types of natural disasters (Tebaldi et al. 2006; IFRCRSC 2004). In much of rural Africa, where water harvesting, irrigation and other similar water management methods are under developed and the impacts of climate change are expected to be especially pernicious, managing agricultural production risk becomes increasingly important (Thornton et al. 2008; Hellmuth et al. 2007).

Climate risk substantially impacts the potential of agricultural output, growth in the sector, and by extension, the welfare of the majority of rural-folk whose livelihood is largely dependent on the agricultural sector. The dampening effects of climate extremities are two-fold: ex-post impacts of adverse climate shocks and inefficient ex-ante behavioral response to uncertainty. The ex-post effects are well known and documented. Where a shock significantly impacts a households earning potential, by, for example, wiping away a substantial fraction of their livestock assets or causing crop failures that force households to default on loans and constraint their future credit worthiness, affected households may find it difficult, if at all possible, to recover (McPeak and Barrett 2001; Dercon 2004; Carter and Barrett 2006; Barrett et al. 2007) People's response to shock can also have long lasting consequences in the absence of formal credit or savings support. Evidence shows that poor households often liquidate productive assets to cope with shock, threatening their capacity to recover (Krishna 2006).

Where the consequence of asset loss may trap households in perpetual poverty, the poor may instead tighten their belts forgoing consumption to protect critical assets (Zimmerman and Carter 2003; Barrett et al. 2006; Hoddinott 2006). Where this decision manifests in reduced quality and quantity of food consumed, foregone health care, or forces households to withdraw children from school, the resulting nutritional and educational deficiencies can have long lasting negative impact on future household productivity (Dercon and Hoddinott 2005; Barrett et al. 2006; Hoddinott 2006; Carter et al. 2007).

Due to the costly nature of these coping responses, households often pursue costly strategies that limit their exposure to risk. Especially among the poor who are generally more risk averse, they may be more likely to prefer low-return but low-risk livelihood options to higher return but higher risk ones. Avoiding risk dampens incentives to adopt new technologies such as improved seed and reduces investments in building herds or farms (Morduch 1995; Zimmerman and Carter 2003; Dercon 2005; Carter and Barrett 2006).

The increasing recognition of the considerable risks faced by the smallholder agricultural sector and the non-trivial impact of these risks on agricultural growth and rural welfare have placed a spot-light on risk and lifted the management of risk to a place of priority with regards to interventions to catalyze agriculture in rural Africa (World Bank 2005a). Fortunately, the past several years have seen the development of promising market-based interventions in managing weather-related agricultural risk. Index-based insurance products represent a promising and exciting option for managing climate related risks that vulnerable households are exposed to.

The creation of insurance markets for events whose likelihood of occurrence can be precisely calculated and associated to a well defined index is increasingly being championed as a way by which the benefits of insurance can be offered to relatively poor and remote populations (Barrett et al. 2008; Skees and Collier 2008; Skees et al. 2006;). Index-based insurance holds considerable appeal for both commercial and development purposes because it allows for management of covariate risk – particularly those related with weather fluctuations – and avoids the serious adverse selection and moral hazard problems that have long plagued conventional crop and livestock insurance programs throughout the world.

This paper underscores the potential of index based insurance to manage weather related risk faced by rural farmers and livestock keepers by highlighting a comprehensive effort to catalyze a commercial market for index-based livestock insurance (IBLI) in Northern Kenya. This effort represents one of two index-based insurance programs worldwide that are designed to protect against livestock mortality – the other being an ongoing program in Mongolia initially developed and supported by the World Bank in 2005 (World Bank 2005b; Skees and Enkh-Amgalan 2002). All other index-insurance pilots from India, to Mexico and Peru, Ethiopia, Malawi and elsewhere insure crops ranging from wheat and groundnuts to cotton and hot-peppers (Carter et al. 2009; Gine et al. 2008; Skees and Collier 2008; Hess and Syroka 2005). While the contract design of IBLI is necessarily particular to the livestock production system of Northern Kenya for which it is developed, the principles of index-insurance development are largely similar for both crop and livestock products as are the implementation challenges, the pre-requisites for successful implementation and adoption and the opportunities for increased production and market development that it stimulates.

In the next section we summarize the main principles of index-based insurance contracts. In section three we zoom into Northern Kenya highlighting some of the key characteristics of its economy that make it particularly suitable for risk-management via index-based insurance contracts. After describing the data we used, we present the contract design and structure followed by a preliminary summary of the target populations expressed willingness to pay for insurance. Section four for details key issues and challenges involved in the implementation agenda and finally, Section five concludes.

2. Index-Based Insurance

Like any insurance product, index-based insurance aims to compensate clients in the event of a loss. Unlike traditional insurance, which makes payouts based on case-by-case assessments of individual clients' loss realizations, index-based insurance pays policy holders based on an external indicator that triggers payment to all insured clients within a geographically-defined space. For index insurance to work, there must be a suitable indicator variable (the index) that is highly correlated with the insured event. Using a data source that is promptly, reliably, and inexpensively available (and not manipulable by either the insurer or the insured), an index insurance contract makes the agreed indemnity payment to insured beneficiaries whenever the data source indicates that the index reaches the "strike point," or insurance activation level.

For example, if one is insuring against livestock mortality, then rainfall or forage availability may be suitable indicators if drought or a shortage of forage, or a combination of the two, often result in above-normal livestock mortality. One could then write an insurance contract based on (some statistically-specified function of) a rainfall or forage indicator to protect against specified levels of aggregate livestock losses. The contract would specify its geographical reach, temporal (or seasonal) coverage, the strike level, the relevant premium and payment terms.

An index-based insurance product has significant advantages over traditional insurance. Traditional insurance requires that the insurer monitor the activities of their clients and verify the truth of their claims. For relatively small clients in infrastructure-deficient environments like the northern Kenyan ASALs, the costs of such monitoring are often prohibitive. With index-based insurance products, all one has to do is monitor the index, thereby sharply reducing costs. Furthermore, by using an index based on variables that cannot be influenced by any insuree's behaviour, index-based insurance products overcome the key problems with traditional insurance contracts of an individual's experience: that more (less) risk-prone individuals will self-select into (out of) the contract and that insured individuals have an incentive to take on added risk – phenomena known as "adverse selection" and "moral hazard," respectively.

These gains from index-based insurance come at the cost of "basis risk", which refers to the imperfect correlation between an insuree's potential loss experience and the behaviour of the underlying index on which the insurance product payout is based. Individuals can suffer losses specific to them but fail to receive a payout because the index does not trigger. On the other hand, lucky individuals may receive indemnity payments that surpass the value of their losses. While this problem cannot be completely eliminated, we have carefully designed the IBLI contract to minimize basis risk and therefore to maximize its value to the insured population.

2.1 Economic and Social Returns to IBLI for the ASAL

In Kenya's arid and semi arid lands (ASALs), drought is the most pervasive hazard, natural or otherwise, encountered by households on a widespread level. This is especially true for northern Kenya, where more than 3 million pastoralist households are regularly hit by increasingly severe droughts. In the past 100 years, northern Kenya recorded 28 major droughts, 4 of which occurred in the last 10 years. For livelihoods that rely solely or partly on livestock, the resulting high livestock mortality rate has devastating effects, rendering these pastoralists amongst the most vulnerable populations in Kenya. As the consequences of climate change unfold, the link between drought risk, vulnerability and poverty becomes significantly stronger.

In such an environment, the economic and social returns to an effective program that insures pastoral and agro-pastoral populations against drought-induced livestock losses can be substantial. To the extent that the likelihood of severe herd mortality reduces incentives to build herds, insuring livestock against catastrophic loss would address the high risk of investment in such environments. By thus stabilizing asset accumulation this should improve incentives for households to build their asset base and climb out of poverty, there enhancing economic growth.

One of the principle negative effects of a risky environment is that it depresses the development of financial markets that are a critical pillar of economic growth. Private creditors are often hesitant to offer uncollateralized loans particularly when borrowers' capacity to repay is closely tied to risk outcomes. In such an environment, financiers might become willing to lend if the assets that secure their loans could be insured. Insurance, which can be used as collateral, can thereby "crowd-in" much-needed credit for enterprises and individuals in the region without leaving poor ASAL residents excessively vulnerable to losing assets when nature fails them.

Indeed index-based insurance contracts offered to underwrite weather related crop failure are explicitly credit-linked. In most such cases, banks take out the insurance policies and bundle them with their input loan packages to farmers. Farmers pay for the insurance through increased interest rates on the loans they source and where the rains fail they are absolved from partial (or full, depending on the program) default. In this case, the insurance company compensates the bank for default losses they incur. While crop index-insurance is largely a means toward the ends of improved credit access, livestock index-insurance is primarily aimed at protecting an asset. Nonetheless, by securing assets, the insurance contract offers a vehicle for using livestock as collateral despite the risk.

Finally, because it provides indemnity payments after a shock, livestock insurance could help stem the collapse of vulnerable-but-presently-non-poor households into the ranks of the poor following a drought (or related crisis) due to irreversible losses from which they do not recover. This is a particularly salient point given the increasing empirical evidence of behavioral response consistent with the presence of dynamic poverty traps among pastoralists of Northern Kenya (Barrett and McPeak 2003, Lybbert et al. 2004, McPeak 2004, Santos and Barrett 2006). Poverty traps manifest in the form of a dynamic herd size threshold above which herds accumulate to a high-level equilibrium and below which herds sizes naturally diminish to a low level equilibrium below the poverty line. For those with herd sizes slightly above this threshold, protecting them against losses that will naturally lead them toward chronic poverty is an important priority that IBLI could theoretically fill (Barrett et al. 2007; Chantarat et al. 2009b).

2.2 IBLI Design and Implementation Challenges

Despite the contractual advantages of an index based insurance product as well as the potential economic and social benefits that could arise, four major challenges confront the creation of an IBLI contract.

- *High quality data* are required to accurately design and price insurance contracts and determine when payouts should be made.
- *Design of an optimal insurance index* that to the maximum extent possible reduces the risk borne by the target population so that the value and potential demand for the product are high;
- *Effective demand* for IBLI insurance among a target clientele largely unfamiliar with insurance in general and index-based agricultural insurance in particular; and,
- *Cost-effective ways of delivering* IBLI insurance to small and medium scale producers in remote locations.

Given the promise of IBLI to manage the considerable drought-related mortality risks that pastoral and agro-pastoral populations face and the challenges associated with introducing a novel and relatively complex product to a remote and largely illiterate population, it was necessary to develop a comprehensive research and development agenda that would incorporate the design of a context-specific IBLI contract, the understanding of demand and ex-ante impact assessment for the target clientele, and create the environment necessary for a successful pilot. The following section highlights some of the key activities undertaken within this agenda.

3. Piloting IBLI in Northern Kenya

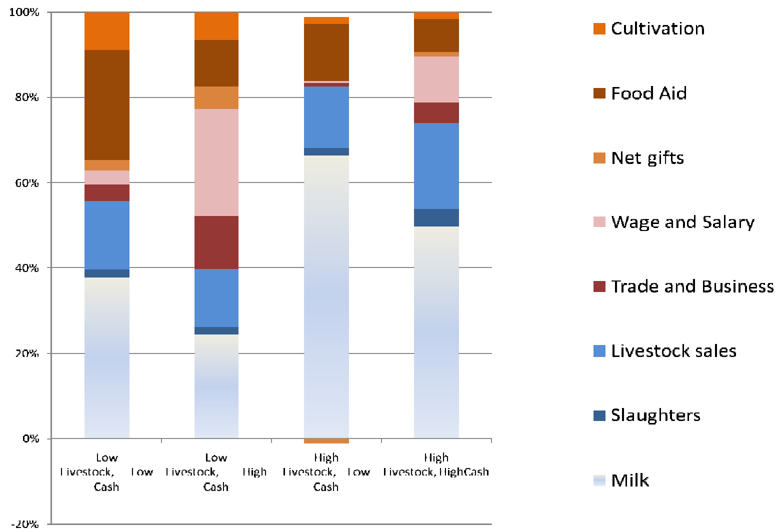
3.1 Overview of the Livestock Economy in Marsabit District

The value of an IBLI contract for underwriting risks depends on the role that risk plays within the target economy and how amenable it is to indexing. In other words, is it a risk that is largely covariate in nature, impacts a substantial number of the insurable population over a sufficiently wide spatial area, and is highly correlated to a readily observable and available non-manipulable variable that can serve as the index? These characteristics, which we sought as a precondition for a suitable pilot location, are found in the livestock economy of Marsabit District in Northern Kenya.

Northern Kenya's climate is generally characterized by bimodal rainfall with short rains falling October – December, followed by a short dry period from January-February, and long rains in March-May, followed by a long dry season from June-September. Pastoralists rely on both rains for water and pasture for their animals, as well as occasional dryland cropping. Pastoralism in the arid and semi-arid areas of northern Kenya is nomadic in nature, where herders commonly adapt to spatiotemporal variability in forage and water availability through herd migration.

Livestock represent the key source of livelihood across most ASAL households. As Figure 1 shows, when households are split across four categories – high and low cash income and high and low livestock holdings (where the threshold for high/low is determined by median value), only the low livestock, high cash households obtain less than 50% of their income from livestock.

Figure 1: Income Sources By Livelihood Grouping



Source: PARIMA 2000-2002

The danger is that livestock face considerable mortality risk, rendering pastoralist households vulnerable to herd mortality shocks. Among these, drought is by far the greatest cause of mortality (Figure 2A) and drought-related deaths largely occur during severe shocks, as during the rain failure of 2000 (Figure 2B). IBLI is designed for precisely these instances of considerable loss. During times of relative normalcy, mortality arises relatively randomly due to non-drought related mortality causes such as diseases and predators. Such losses can be self insured. IBLI is designed to cover those more severe shocks which pose a greater threat to livelihoods.

Figure 2A: Causes of Livestock Mortality

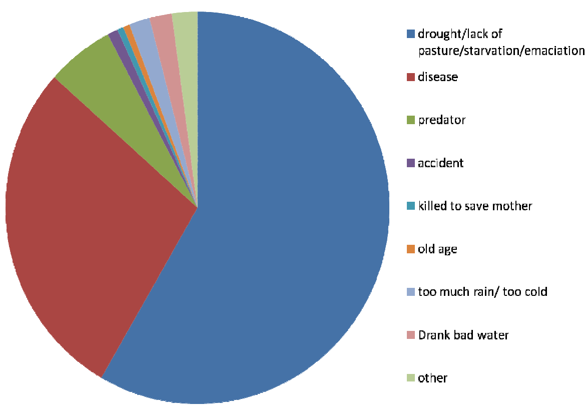
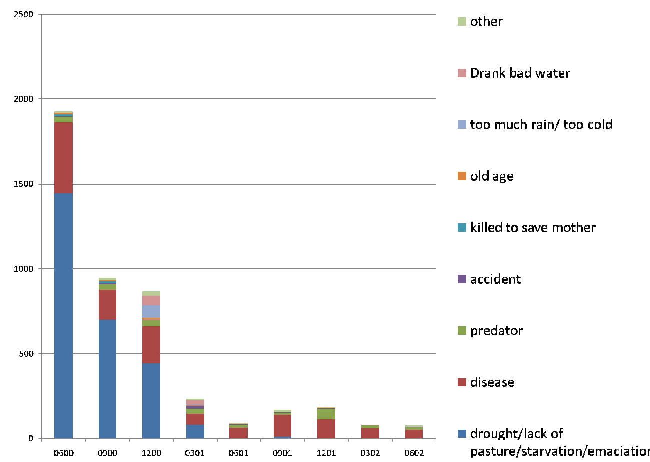


Figure 2B: Causes and Relative Number of Livestock Losses by Season



Source: PARIMA 2000-2002 data

3.2 Data Source

Given the comprehensive nature of the research agenda, several data sources where needed to complete all necessary tasks.

3.2.1 Contract Design Data

To design and price the IBLI contract itself, we had to find a measure that is (1) highly correlated with local livestock mortality; (2) reliably and cheaply available for a wide range of locations; and, (3) historically available to allow pricing of product. The Normalized Difference Vegetation Index (NDVI) meets these conditions. Constructed from data remotely sensed from satellites, NDVI is an indicator of the level of photosynthetic activity in the vegetation observed in a given location. As livestock in pastoral production systems depend almost entirely on available forage for nutrition, NDVI serves as a strong indicator of the vegetation available for livestock to consume. The NDVI data are available at the resolution of 8.0×8.0 km. Since the late 1980s, the United States' NASA and NOAA have used AVHRR data[2] to produce dekadal (10-

[2] NDVI is derived from data collected by National Oceanic and Atmospheric Administration (NOAA) satellites, and processed by the Global Inventory Monitoring and Modeling Studies group (GIMMS) at the National Aeronautical and Space Administration (NASA).The NOAA-Advanced Very High Resolution Radiometer (AVHRR) collects the data

day) composite NDVI images of Africa, and have built a valuable archive of these data from June 1981 to present, which are available in real time and free of charge.[3]

While NDVI has properties that make it reliable as the basis for an insurable index, it must also have value for the insured. In other words, NDVI data has to predict livestock mortality rates reasonably well. We used household-level livestock mortality data collected monthly since 2000 in various communities in Kenya's ASAL districts by the Government of Kenya's Arid Lands Resource Management Project (ALRMP) and by the USAID-funded Pastoral Risk Management (PARIMA) Project to statistically estimate the relationship between NDVI measures and observed livestock mortality. Our current contract is based on Marsabit District, the focus for the pilot. As detailed below, we combined those herd history data to create an optimal insurance index defined as the function of the NDVI data that is simple, replicable, commercially implementable and highly correlated with the herd mortality data so that it provides the maximum possible insurance value to the pastoralist population.

3.2.2 Data for demand-side analysis

In order to appropriately understand the target client's attitudes toward risk, to study their demand for insurance and conduct ex-ante impact assessments we conducted in-depth community and household level surveys among pastoralists in five communities in Marsabit district (Dirib Gombo, Karare, Logologo, Kargi and North Horr) chosen purposively to vary in terms of pastoral production system, market access and agroecology. The main objectives of the surveys were to (1) have full understanding of pastoralists' nature of livestock losses, their perceptions about risk of livestock loss and climate, (2) introduce potential clients to the concept of IBLI, and (3) investigate patterns and determinants of demand and willingness to pay for IBLI.

After an initial introductory focus group discussion with approximately 15-20 community members, we fielded a household survey in each location in which 42 households per location were randomly drawn using stratified sampling by wealth class. The household survey collected household level information, production data, risk profiles, the history of herd

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used to produce NDVI. Values of NDVI for vegetated land generally range from about 0.1 to 0.7, with values greater than 0.5 indicating dense vegetation.

[3] Further details about NDVI are available at http://earlywarning.usgs.gov/adds/readme.php?symbol=nd.

dynamics, perceptions about risk of livestock loss and other relevant information. These households were later brought together to take part in an experimental game designed to replicate existing pastoral production systems, which we used to illustrate how index insurance would work and how it could be beneficial (McPeak et al. 2009). Having educated participants on the general structure of IBLI and how it works, we then returned to each household for a follow-up interview where we sought to understand the determinants of demand for insurance as well as respondents willingness-to-pay for insurance (Chantarat et al. 2009c). These data are used to understand patterns of livestock mortality, climate and pastoralists' needs for appropriate contract design, investigate patterns and determinants of demand and willingness to pay for IBLI as well as in conducting basis risk and contract performance analysis.

3.3 Contract Design and Terms[4]

The key feature of the contract we design is modeling a statistical predictive relationship between livestock mortality within a specific area and the satellite based indicator of forage availability NDVI. Equation (1) below presents a simplified version of the regime-switching regression model we estimate to generate the key relationship underlying the IBLI contract. The area averaged livestock mortality rate in location *l* in season *s*, M_{ls}, is estimated as the following regime-switching regression model:

$$M_{ls} = M_g(ndvi) + \varepsilon_{gls} \quad \text{if good climate regime } (Czndvi\_pos_{ls} \geq 0)$$
$$M_{ls} = M_b(ndvi) + \varepsilon_{bls} \quad \text{if bad climate regime } (Czndvi\_pos_{ls} < 0) \qquad (1)$$

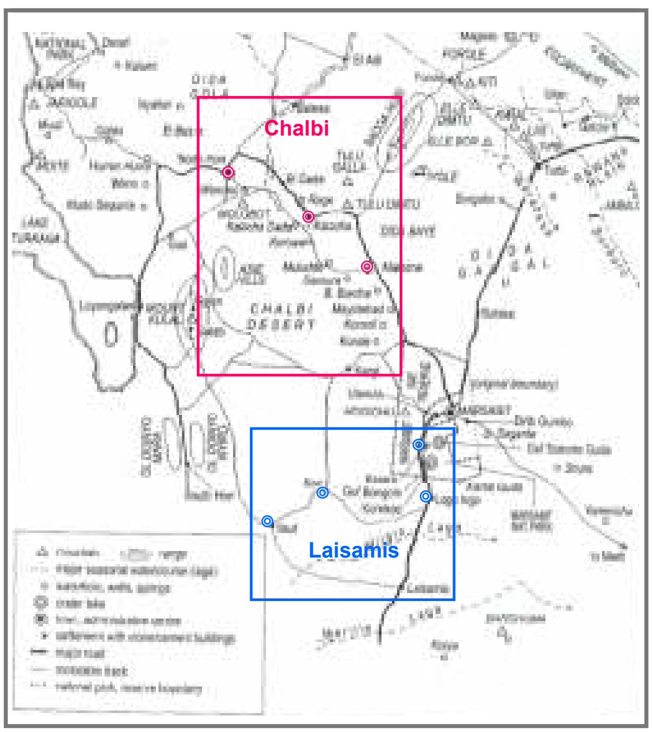
where $ndvi$ represents the constructed explanatory variables based on NDVI, and ε_{ils} is the risk components not explained by climate (e.g., due to disease outbreak, livestock raiding, wildlife predators, etc.) in the bad (i=b) and good (i=g) regimes. The regimes are defined by the accumulated deviation of value of NDVI from its long-term average from the last rainy season until the end of the current season ($Czndvi\_pos_{ls}$). We constructed the actual seasonal

[4] In this sub-section we present the modeled contract in simplified form and do not delve deeply into the key design issues. For a more detailed and technical description and analysis, please see Chantarat 2009a.

livestock mortality rates[5] based on 2000-2008 mortality data and NDVI-based mortality index based on 1982-2008 NDVI data for both LRLD and SRSD seasons. Figure (X) below is a simple heuristic representation of the core of the IBLI contract; the response function that translates observed NDVI data into a statistically reliable predictor of livestock mortality as depicted in Equation (1)

Our analysis revealed that, to improve precision of contracts, it was necessary to divide Marsabit district into two zones or clusters, each distinguished by its own response function. The 2 distinct geographic zones (Figure 3), which we term the Laisamis Cluster and the Chalbi Cluster were divided based on statistical cluster analysis, which bundles locations with similar characteristics, such as distribution of species within a herd, mortality rates and variables that may influence the predictive relationship between livestock mortality and NDVI. The Chalbi cluster is drier and its herds have a higher fraction of camels and smallstock while in Laisamis cattle dominate.

Figure 3: Chalbi and Laisamis contract coverage clusters



[5] We aggregate across livestock species using the tropical livestock unit (TLU) measure, where 1 TLU = 1 cattle = 0.7camel = 10 goats or sheep.

With the response function estimated, we then estimate the actuarially fair premium rate per season per value of TLU livestock insured for location *l* in season *s* covering the loss event that the predicted area averaged mortality index $\hat{M}_{ls}$ is beyond the mortality strike of M_l^* can be written as:

$$p_{ls}\left(M_l^*\right) = E\left(Max\left(\hat{M}_{ls} - M_l^*, 0\right)\right) \qquad (2)$$

where $E(\cdot)$ is the expectation operator over a distribution of NDVI based mortality index. The mortality strike M_l^* is the mortality level for location *l,* additional losses beyond which the contract will compensate for. The simplified pricing equation presented in Equation (2) above is the actuarially fair premium rate (%) per value of aggregate livestock insured. We report the estimated premium rates for contracts with various strikes for both clusters in Table 1.

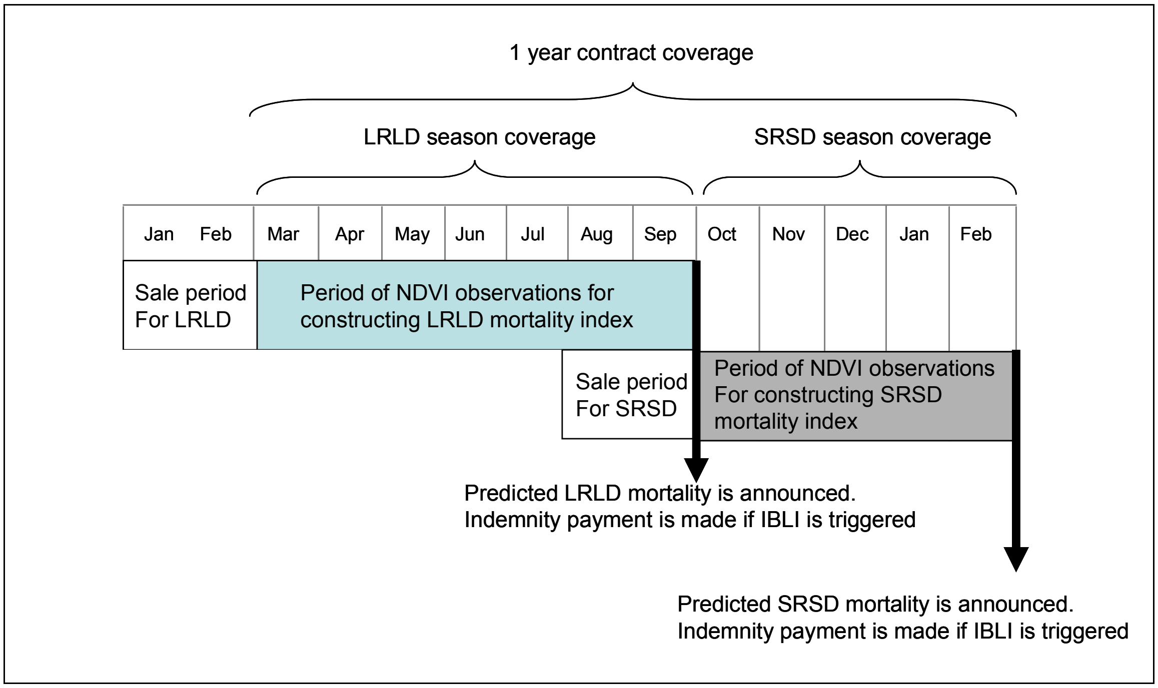
Table 1: Calculated Premiums for Unconditional Contracts across Strike

Cluster/Contract	**Premium Rate (% of insured value)**			
	10% Strike point	*15% Strike Point*	*20% Strike Point*	*25% Point*
Chalbi Cluster	**9%**	**5%**	**3%**	**1%**
Laisamis Cluster	**5%**	**3%**	**1%**	**1%**

The Chalbi cluster, which is much drier and thus prone to more drought-related livestock deaths has generally higher priced contracts. As expected, the lower the strike level beyond which indemnity payments are triggered, the higher is the premium as compensation is more likely to occur.

Temporal coverage of the contract is likewise an important feature the contract must specify. Unlike conventional insurance products, index insurance is only sold within a specific window of time – before any signal emerges as to how the insured climate will unfold. The contract that we price above is a one-year contract that has two potential trigger points per year (one at the end of each dry season) and would be sold before either of the short or long rains but with a one year coverage duration thereafter. It is also possible to offer a seasonal contract (each encompassing a rainy and dry season pair), with the contracts sold before the rainy period of each season and assessed at the end of the dry period to determine whether payouts are to be made (See Figure 4 below).

Figure 4: Temporal structure of IBLI contract



The performance of the contracts can be analyzed by looking at how well the predicted mortality index corresponds to the actually area-averaged mortality in the target area. We present these results for both clusters and various insurance triggers in Table 2. Predictive relationships for both clusters maintain a considerably high probability of correct trigger decisions even for out-of-sample forecasting using PARIMA data. We define a correct decision as occurring when the model predicts mortality rates above the trigger and actual data shows that indeed mortality rates were above the trigger level. Correct decisions are also made when the model fails to trigger and actual mortality also did not register above the trigger. Where errors occur, they are quite well distributed between Type 1 (when beyond-strike loss is experienced but no payout is triggered) and Type 2 (payout is triggered when experienced loss is below the relevant strike) errors in the in-sample predictions. However, for out-of-sample predictions, the model seems to have a tendency for under-predicting (over-predicting) mortality loss experience in Laisamis (Chalbi). The model will thus need to be tweaked to control for this systematic tendency.

Table 2: Insurance Contract Performance

Cluster	Strike	Proportion of sample					
		In-sample			**Out-of-sample**		
		Correct trigger decision	**Incorrect decision**		**Correct trigger decision**	**Incorrect decision**	
			Type 1 Error	Type 2 Error		**Type 1 Error**	**Type 2 Error**
Chalbi	**10%**	0.71	0.13	0.17	0.75	0.25	0.00
	15%	0.81	0.06	0.13	0.88	0.00	0.13
	20%	0.88	0.04	0.08	0.75	0.00	0.25
	25%	0.85	0.10	0.04	0.88	0.00	0.13
	30%	0.94	0.04	0.02	0.88	0.00	0.13
Laisamis	**10%**	0.80	0.09	0.11	1.00	0.00	0.00
	15%	0.88	0.03	0.09	1.00	0.00	0.00
	20%	0.84	0.09	0.06	0.75	0.25	0.00
	25%	0.81	0.14	0.05	0.75	0.25	0.00
	30%	0.84	0.13	0.03	0.75	0.25	0.00

3.4 Investigating Demand for IBLI

With the contract designed, the obvious question is: Will the target clientele actually appreciate the intervention and if they do, will they be willing to purchase it at commercially sustainable rates? We believe that pragmatic market-driven solutions to risk-management are likely to be more sustainable, to organically respond to client needs and to scale up more efficiently and have thus designed the IBLI contract as well as the implementation agenda which we discuss in the following section, to be market mediated.

However, commercial success will only come if their exists sufficient demand at commercial rates to make IBLI market-viable. To investigate this, sample households were asked to demonstrate their willingness to pay for IBLI by way of the double bounded contingent valuation technique that seeks to estimate unobserved willingness to pay by soliciting the lower bound (highest price at which they would buy) and upper bound (lowest price at which they would not buy) of their valuation. To ensure that respondents would have a good idea of characteristics of IBLI and thus its potential value to them, they all previously underwent a comprehensive education program in the form of a game as explained further in the following section. Preliminary analysis, further investigated in more rigorous detail in Chantarat 2009b), offers some revealing results.

Table 3: Percent of Respondents Willing to Pay At least the Stated Amount for ILBI by Location

Location	10% Strike		30% Strike	
	Fair	Fair +20%	Fair	Fair +20%
Overall	50%	34%	69%	69%
Dirib Gombo	71%	41%	78%	78%
Kargi	46%	32%	50%	50%
Karare	81%	75%	100%	100%
Logologo	30%	14%	57%	57%
North Horr	35%	22%	71%	71%

Table 3 above presents the percent of our sample across location who had a willingness to pay for IBLI at or above the quoted prices. Two prices were quoted, the actuarially fair price and the fair price with a 20% loading to account for possible mark-up and other business costs that may be associated with commercial provision. On average more that one third of the sample indicated a willingness to pay at least 20% above the fair price for the 10% strike contract, a figure that jumped to almost 70% for a 30% strike contract. One reason the 30% strike contract is likely to be more popular is because it is much cheaper. This also explains the lack of variation between the fair and fair + 20% contracts. At such low costs, an additional 20% is often times trivial.

When disaggregated by wealth class (Table 4), it becomes clear that wealth is not a significant determinant of demand. It does seem however, that the households with lower wealth have a slightly higher demand for the 10% strike contract that though more expensive, is likely to pay out more frequently. On the other hand, higher wealth households have a higher demand for the 30% strike contract. This could be explained by the fact that poor households are believed to be more risk averse and would be more willing to pay to protect themselves against the consequences of risk. Moreover, wealthier households are capable of self-insuring against relatively minor losses but would want to protect against severe depletions of their wealth. Within the insurance sector, especially in the growing agricultural sub-sector, these numbers are sure to excite. A national survey of financial access in Kenya found that over 90% of respondents had never used an insurance survey a figure that jumped to 95% with regards to the rural population (Finaccess, 2007).

Table 4: Percent of Respondents Willing to Pay At least the Stated Amount for ILBI by Wealth Class[6].

Wealth Class	10% Strike		30% Strike	
	Fair	Fair +20%	Fair	Fair +20%
Low	53%	39%	69%	69%
Medium	49%	33%	68%	68%
High	45%	22%	86%	86%

4. Implementation Challenges

With the willingness to pay efforts indicating a likelihood of demand capable of sustaining a commercial product, the next logical step is to deliver the product to target clientele. Indeed, it was the motivation to identify and develop risk-management innovations suited to pastoralist and agro-pastoralist populations in ASAL regions that drove the agenda to design and develop IBLI contracts that can help reduce the vulnerability to the greatest risk they face – drought related livestock mortality. Consequently, the provision of a sustainable product, initially implemented in a trial pilot, has been a key component of the overall agenda. In what follows, we outline some of the key activities and challenges surrounding our effort to implement a pilot of the contract described in this paper in Marsabit District of northern Kenya.

4.1 Educating target clientele

Experience with other index-insurance pilots have shown that a carefully designed program of extension to appropriately educate potential clients is a necessary prerequisite to both initial uptake and continued engagement with insurance (Gine et al., 2007; Sarris et al., 2006). Index-insurance products are complex to understand and even more so for populations in remote rural areas with low levels of literacy and minimal previous experience with formal insurance products. A prerequisite to generating demand and ensuring that the risk-

[6] Wealth classification standards vary by location. The boundaries in TLU for (L, M, H) wealth class for the five locations are Dirib (<3, 3-8, >8), Kargi (<15, 15-25, >25), Karare(<15, 15-30, >30), Logologo (<10, 10-25, >25) and North Horr (<15, 15-35, >35)

management benefits of insurance effectively serve the client is for them to clearly understand the value of insurance and, in particular, how an index insurance product works.

In order to design an extension tool that adequately captures the complexities of the IBLI product, and relay the key features of the contract terms, we took cue from the growing field of experimental economics. Experimental games, the main tool of this field, offers methods by which complex concepts can be distilled and taught in a relatively simple manner, and dynamic decisions or processes can be easily repeated during game play to mirror the consequence and elicit the behavioral response that could otherwise take years to understand.

A good experimental game that can impart important insights and lessons onto its 'players', needs to ensure that the simplified abstract game mirrors the real world (in this case the actual features of IBLI contracts and their interaction with the pastoral production system) as much as possible. As such, we designed our IBLI educational game to replicate the herd dynamics that livestock keepers in the rangelands face. It is after all the significant troughs in these dynamics that IBLI is designed to protect against.

The game was played in four different rounds of increasing complexity. Each round was composed of ten bi-annual seasons (short rain/short dry and long rain/long dry) or five years which would track herd growth (or loss) as a function of climate conditions and, in later rounds, individual luck (this to emphasize probability of basis risk). Participants were each offered a starting herd size (various colours of poker chips represented the different livestock types and some liquidity whose relative terms of trade were modelled to reality) and in each season, an opportunity to purchase insurance.

In each season climate decisions were determined randomly by picking from an opaque bag that contained 16 balls, each specifying one of five climactic conditions (We explained climate as a function of forage conditions and explained that these were generated by satellites. When satellites were explained as "those moving stars you see at night", all participants seemed to understand). The distribution of balls across climate (Table 5) was set to largely mirror the distribution of climactic conditions across Marsabit, as was the impact of the seasons on herd growth.

Table 5: Mortality Impact and Distribution of Climactic Conditions in Experimental Game

Type of Climactic Condition	Number of (seasonal) balls	Frequency of occurrence (%)	Growth (loss) impact on herds
Severe Drought	1	6	-30%
Drought	1	6	-20%
Below average	2	12.5	+ 0%
Normal	7	43.8	+10%
Good	5	31.3	+20%

IBLI contract at 10% strike was used in the experimental game. For those who purchased insurance, indemnities were paid out according to Equation (2) when a "severe drought" or a "drought" occurred. Through each round of the game, different lessons were emphasized and by the final round, game play and final discussions suggested that participants had grasped the main lessons of the game. While such a tool is arguably the most effective way to educate clients on the workings of an IBLI contract, it is also expensive. The game takes the better part of a day to play and two facilitators per five participants are often required. As such, playing the game at a large scale is not likely to be commercially attractive and more cost-effective methods need to be developed. These could perhaps be in the form of skits, or highlighted portions of the game presented as videos that could be distributed and played in various forums in the target communities.

4.2 Delivery channel

The pilot district, Marsabit, is a remote, sparsely populated and relatively infrastructure deficient area. As such, in thinking through product and implementation, one cannot ignore the hardships that may arise in targeting clients, accepting premiums, and making indemnity payments within a system that generates enough confidence to allow for active market mediation. Insurance companies would need to develop a cost-effective administrative infrastructure and identify the agents necessary to conduct transactions on their behalf.

Fortunately, a substantial social protection program dubbed the Hunger Safety Net Program (HSNP), funded by the U.K. Department for International Development (DfID), is rolling out in four of Kenya's poorest districts in early 2009. Within a year, and for the first four year phase of its ten-year expected duration, the HSNP plans to deliver regular cash transfers to 60,000 households spread across Mandera, Marsabit, Turkana and Wajir. This is a huge task for which a well-designed delivery channel with a wide network across these regions is required.

The Financial Sector Deepening Trust (FSD), in conjunction with Kenya's Equity Bank, have been working on just such a delivery channel and have the responsibility of creating the necessary Information and Communication Technology (ICT) and financial infrastructure needed to support the HSNP program. Equity Bank has been contracted to open over 150 new Points of Sale (PoS) across these regions that will be able to facilitate and provide the HSNP cash transfer to recipient households. Using new hi-tech portable devices within a sophisticated computing system, these PoS devices can be easily configured to accept premiums for certain insurance contracts and register indemnity payments when necessary. Discussions are underway to ensure that FSD and Equity Bank offer index-insurance contracts on the back of their delivery chain. Where we would like to offer the product in Marsabit communities not selected to receive HSNP cash transfers, it would be easy to extend the network to these areas.

Even with the fortune of utilizing the infrastructure set up by FSD/Equity, there are still regulatory hurdles to jump through. Because the product is an insurance program, the Insurance Regulatory Agency of Kenya (IRA) will have to study it and formally approve both the design of the product and the contract terms. In addition, if the product is to be delivered through banking infrastructure, the Central Bank of Kenya (CBK) will also need to weigh in. The fact that the product is a new innovation into the market and has a complex design to it may also pose some challenges.

4.3 Productive Safety Net or Commercial Product

A further issue that we will need to clarify has to do with the seemingly dual roles of the insurance contracts. As designed and championed, we see the insurance contracts as commercial products that can be successfully and sustainably offered through the market. Much of the efforts we have pursued have been to investigate demand and price products in order to build a market case for the contracts. Results for the pilot test will go a long way in establishing the long term commercial viability for IBLI.

The genesis for IBLI products, however, came from the recognition of the role they could play as a productive safety net (PSN) in ASAL areas dominated by pastoral production where widespread livestock mortality often robbed individuals of their livelihoods and forced them into sedentarization and poverty. IBLI products that are well designed and targeted theoretically offer a superior mechanism for welfare enhancements and livelihood protection than regular cash transfers – particular in communities that evidence poverty traps as those we are targeting do (Chantarat 2009b; Barrett et al. 2008). As such, IBLI could also be used as a PSN complement in broader social protection programs.

This distinction between IBLI as commercial product and IBLI as productive safety net could result in some confusion and unless well designed and articulated, may jeopardize one or the other element of the program. We clarify that the structure and terms of the contract as well as the delivery channels, are the same whether the insurance is offered commercially or as a safety net. As we envision it, the safety net will only be a temporary measure that, if and when activated, would operate as a discount subsidy on the regular premiums. The discount would be offered to targeted recipients but paid by government or donor institutions directly to insurance companies. As such, from the point of view of the insurance company, the only change to their operations will be the receipt of the subsidized portion of premium payment from external agencies.

We should stress our hypothesis that the product will be driven by larger scale producers (upwards of 10 heads of cattle or the equivalent in other livestock species) who own the great majority of cattle and who will not likely be eligible for a premium discount through a PSN program. As such the only glitch to a seamless integration of both elements/objectives of IBLI may be the issues of false expectations generated by a one-time receipt of discount as well as claims of unfairness and the possible social tension and attendant market impact that may result. However, well designed extension tools that clarify the selection process for PSN recipients, the rationale behind it, and how the discount premium works should go a long way toward solving this potential problem. We plan for a rigorous, four year long M&E effort, which will be designed to manufacture price variation (different recipients will randomly receive different premium discounts), will allow policy makers to gain insights on the value of insurance subsidies for generating desired movement in key indicators (eg. income, asset growth, access to finance, etc), as well as getting a sense of optimal pricing (which should also be valuable information to insurance companies).

5. Conclusion

The effort to design and pilot IBLI as a commercially sustainable tool to help the pastoralists of Northern Kenya insure themselves from drought related livestock mortality is entering its implementation stage. It was a process that began with the identification of the key source of vulnerability plaguing pastoralists and the recognition that IBLI may be a promising intervention to help manage the main source of risk they face – widespread livestock losses due to drought. What followed was an effort to investigate the feasibility of developing an IBLI product. Marsabit district, where the first IBLI contracts will initially be piloted, met all the necessary prerequisites for development; the data needed to model IBLI was available, harsh droughts were established as the cause of livestock mortality in an area were livestock formed the backbone of livelihoods, research identified the likelihood of demand capable of supporting a market mediated product, and the delivery infrastructure for the provision of the contracts was put in place by a complementary project.

What now remains is to finalize agreements between key implementing partners and to get formal approval by regulators. In addition, an extension and marketing program based on the education game but far less resource intensive must be developed and all key personnel trained. Given that contracts can only be sold in the two months before the start of a rainy season (See Figure 4) the pilot shall launch in either September 2009 or February 2010. Along side this will be a baseline survey that will track a random selection of households in the coverage area (both those opting to purchase IBLI and those who do not) for a period of four years, returning to resurvey each respondent yearly in order to assess the impact of IBLI over a set of key welfare indicators.

REFERENCES

Barrett, C.B. and J.G. McPeak. 2005. "Poverty Traps and Safety Nets." In A. de Janvry and R. Kanbur, eds., *Poverty, Inequality, and Development: Essays in Honor of Erik Thorbecke*. Norwell MA: Kluwer Academic Publishers.

Barrett, C.B., M.R. Carter and P.D. Little, eds. 2007. *Understanding and Reducing Persistent Poverty in Africa*, London: Routledge,.

Barrett, C.B., Barnett, J.B., Carter, M.R., Chantarat, S., Hansen, J.W., Mude, A.G., Osgood, D.E., Skees, R. J, Turvey C.G., and M. Neil Ward. 2007. "Poverty Traps and Climate Risk; Limitations and Opportunities of Index-Based Risk Financing" IRI Technical Report No. 07-02.

Barrett, C.B., Carter, M.R., and M. Ikegami. 2008. "Poverty Traps and Social Protection," Working paper, Cornell University

Carter, M.R., Galarza, F., and S. Boucher. 2009. "Underwriting Area-Based Yield Insurance to Crowd-In Credit Supply and Demand." Forthcoming in *Savings and Development.*

Carter, M.R., and C.B. Barrett. 2006. "The Economics of Poverty Traps and Persistent Poverty: An Asset-based Approach." *Journal of Development Studies* 42(2):178–199.

Carter, M.R., P.D. Little, T. Mogues, and W. Negatu. 2007. "Poverty Traps and Natural Disasters in Ethiopia and Honduras." *World Development* 35(5):835–856

Chantarat, S., Mude, A., Barrett, C.B., and Michael Carter (2009a). "Designing Index Based Livestock Insurance for Managing Drought-Related Livestock Asset Risk in Northern Kenya." Working Paper, Cornell University

Chantarat, S., Mude, A., Barrett, C.B., and C. Turvey (2009b). "Effectiveness of Index Based Livestock Insurance for Managing Asset Risk and Improving Welfare Dynamics in Northern Kenya." Working Paper, Cornell University

Dercon, S. 2004. "Growth and Shocks: Evidence from Rural Ethiopia." *Journal of Development Economics* 74:309–329.

Dercon, S., and J. Hoddinott. 2005. "Health, Shocks and Poverty Persistence." In S. Dercon, ed. *Insurance Against Poverty*. Oxford: Oxford University Press.

Finaccess. 2007. "Financial Access in Kenya; Results of the 2006 National Survey" Financial Sector Deepening Trust, Kenya.

Gine, X., Townsend, R., and J. Vickery. 2008. "Patterns of Rainfall Insurance Participation in Rural India." *The World Bank Economic Review* 22(3):539-566

Hellmuth, M.E, A. Moorhead, M.C. Thompson, and J. Williams, eds. 2007. *Climate Risk Management in Africa: Learning from Practice.* New York: International Research Institute for Climate and Society (IRI), Columbia University.

Hoddinott, J. 2006. “Shocks and Their Consequences across and within Households in Rural Zimbabwe.” *Journal of Development Studies* 42(2):301–321.

IFRCRCS (International Federation of Red Cross and Red Crescent Societies). 2004. *World Disaster Report 2004.* Bloomfield, CT: Kumarian Press, Inc.

Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007 – Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fourth Assessment Report of the IPCC.

Krishna, A. 2006. “For Reducing Poverty Faster: Target Reasons Before People.” Working paper, Duke University.

Lybbert, T.J., C.B. Barrett, S. Desta, and D.L. Coppock. 2004. “Stochastic Wealth Dynamics and Risk Management among a Poor Population.” *The Economic Journal* 114:750–777.

McPeak, J.G. and C.B. Barrett. 2001. “Differential Risk Exposure and Stochastic Poverty Traps among East African Pastoralists.” *American Journal of Agricultural Economics* 83:674–679.

Morduch, J. "Income Smoothing and Consumption Smoothing." 1995. *Journal of Economic Perspectives* 3:103–114.

Santos, P. and C.B. Barrett. 2006. "Heterogeneous Wealth Dynamics: On the Roles of Risk and Ability.” Working paper, Cornell University.

Sarris, A., Karfakis P., and L. Christiaensen. 2006. Producer demand and welfare benefits of rainfall insurance in Tanzania. FAO Commodity and Trade Policy Research Working Paper No. 18

Skees, J.R., and A. Enkh-Amgalan. 2002. "Examining the Feasibility of Livestock Insurance in Mongolia." Working Paper 2886, World Bank.

Skees, J.R., and B. Collier. 2008. “The Potential of Weather Index Insurance for Spurring a Green Revolution in Africa.” Global Ag Risk Inc.

Skees, J. R., J. Hartell, and J. Hao. 2006. "Weather and Indexed-based Insurance for Developing Countries: Experience and Possibilities." In A. Sarris, and D. Hallam, eds., *Agricultural Commodity Markets and Trade: New Approaches to Analyzing Market Structure and Instability*. Cheltenham UK and Northampton MA: Edward Elgar Publishing, Ltd., for the Food and Agriculture Organization of the United Nations.

Tebaldi, C., et al. 2006. "Going to the Extremes: An Intercomparison of Model-Simulated Historical and Future Changes in Extreme Events." *Climatic Change* 79: 185–211.

Thornton, P., Jones, P., Owiyo, T., Kruska, R., Herrero, M., Orindi, V., Bhadwal, S., Kristjanson, P., Notenbaert, A., Bekele, N., and A Omolo. (2008) Climate Change and Poverty in Africa: Mapping Hotspots of Vulnerability. African Journal of Agricultural and Resource Economics Vol 2 (1)

World Bank. 2005a. “Managing Agricultural Production Risk: Innovations in Developing Countries” The World Bank, Agriculture and Rural Development Department.

World Bank, 2005b. “Livestock Mortality and Vulnerability to Poverty among Mongolia’s Herder Households: A Policy Note.” Poverty Reduction and Economic Management Department, East Asia and Pacific Region. The World Bank, June, 2005.

Zimmerman, F., and M.R. Carter. 2003. "Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints." *Journal of Development Economics* 71(2):233-260.