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Managing Agricultural Risk at the Country Level:
The Case of Index-Based Livestock Insurance in Mongolia

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Abstract

Mahul and Skees describe the index-based livestock insurance program in Mongolia designed in the context of a World Bank lending operation with the Government of Mongolia. This program involves a combination of self-insurance by herders, market-based insurance and social insurance. A syndicate pooling arrangement protects participating insurance companies against excessive insured losses. A World Bank contingent debt facility covers the most extreme losses. This project offered the World Bank, for the first time ever, the opportunity to design and implement an agriculture insurance program using a country-wide agricultural risk management approach developed inside the World Bank.

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1.   Introduction

This paper presents the background and rational for the Index-based Livestock Insurance (IBLI) project in Mongolia. The Government of Mongolia and the World Bank signed a loan for this project in May of 2005. The first sales occurred in 2006 to cover mortality of livestock for the first five months of 2007. Sales were greater than anticipated with nearly 10 percent of the herders purchasing the insurance in the first year. Of more significant, financial intermediaries offering loans to herders provided lower interest rates to those herders purchasing this new form of insurance.

The Mongolian country-side remains a herder-based economy. Agriculture contributes nearly one third of the national GDP and herding accounts for over 80 percent of agriculture. Animals provide sustenance, income, and wealth to protect nearly half the residents of Mongolia. Shocks to the well-being of animals have devastating implications for the rural poor and for the overall Mongolian economy. Major shocks are common as Mongolia is a harsh climate where animals are herded with limited shelter. From 2000-2002, 11 million animals perished due to harsh winters (*dzud*). The Government of Mongolia has struggled with the obvious question of how to address this problem.

In 2001, the Government of Mongolia (GoM) requested assistance from the World Bank to address a problem that has plagued Mongolia for centuries – tremendous death rates in the livestock population. While the country had a social livestock insurance program during the communist period, several attempts to pass a livestock insurance law in recent years have failed. Based on the first involvement from the World Bank in 2001, Skees and Enkh-Amgalan (2002) recommended an index-based insurance program using mortality rates by species and *soum*[2]. This recommendation was motivated by significant concerns regarding moral hazard, adverse selection, and extreme monitoring costs that could would accompany a traditional livestock insurance program in the vast open spaces of Mongolia. Another concern that was highlighted involved the potential for extreme loss exposure associated with any livestock insurance program in Mongolia.

Since the initial recommendations to implement index-based livestock insurance, a significant policy debate within Mongolia has been occurring about alternatives for insuring and financing the extreme losses associated with the death of large number of animals. Given the difficultly in finding solutions that would address both the social and market dimensions of this problem in a fashion that would not strain Mongolia's limited fiscal resources, the GoM requested further research on this issue. The policy recommendations reported in this paper are a product of conceptual developments that have been ongoing inside the World Bank Insurance Practice on agricultural insurance and the research that has followed for the GoM.

The core recommendations involve a combination of self-insurance by herders, market-based insurance and social insurance. Herders retain small losses, larger losses are transferred to the private insurance industry, and extreme or catastrophic losses are transferred to the GoM using a public safety net program. Given that this is a novel approach to a significant problem in Mongolia, the GoM was persuaded to begin a pilot program.

The proposed insurance program relies on a mortality rate index by species in a local region (*sum*). The index provides strong incentives to individual herders to continue to manage their herds so as to minimize the impacts of major livestock mortality events (i.e. individual herders receive an insurance payout based on the local mortality, irrespective of their individual losses). The insurance would pay out to individual herders whenever the mortality rate in the *soum* exceeds a specific threshold. Finally, a 33 year time series on adult animal mortality is available

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[2] In Mongolia a *soum* is equivalent to a county and an *aimag* is equivalent to a state or province.

for all *soums* and for the five major species of animals. Such data are critical for developing actuarial information and for understanding the potential cost of alternative designs.

The large losses reported during 1999-2002 clearly demonstrated that Mongolian livestock is exposed to catastrophic risk and that the potential losses are well beyond the financial capacity of the Government and the domestic insurance market. The new Insurance Law, passed in 2004, was an important step to strengthen the insurance industry through improved regulation and also included a provision for introducing index based livestock insurance in Mongolia. Involving the insurance industry, operating on a commercial basis, has the potential to improve the sustainability of livestock insurance and contributes to strengthening the rural finance sector, which is a key element in Government strategy for rural economic diversification.

It is believed that the index-insurance product can be effectively underwritten. Still significant financial exposure for a nascent insurance market that has extremely limited access to global reinsurance markets remains a significant challenge. Among the most novel aspects of the recommendations is the special financing facility. A syndicate pooling arrangement offers some opportunity to reduce the exposure for any individual insurer. This special pre-paid indemnity pool also assures that herder premiums will be protected until time of loss and that this unique line of business will not create financial contagion for other lines of insurance for the insurance companies. Risks are layered out with insurers paying reinsurance to a reinsurance fund that pays all herder losses beyond a certain threshold for the pool risk. Given that such a reinsurance fund can not be built up fast enough to cover an early extreme loss, a World Bank contingency loan is also available to cover the most extreme losses.

This paper is organized as follows. The country agricultural risk management model developed by the World Bank Insurance Practice is described in Section 2. Section 3 presents the risk assessment analysis of livestock mortality in Mongolia based on catastrophic risk modeling techniques. Section 4 describes the design of the Mongolian livestock insurance program. The pilot study is detailed in Section 5. Section 6 discussed challenges in the implementation and operation of the pilot project. Finally, the key issues are summarized in the conclusion.

2.   Agricultural Productions Shocks: Country Risk Management Approach

Ex post funding by most governments in developing countries and international agencies has been seen as the only response to catastrophic losses. However, this approach turns out to be ineffective, inefficient and insufficient. A country agricultural risk management model is proposed, based on the experience of the World Bank Insurance Practice on the management of natural disasters. Policy implications are derived from this model.

2.1. Ex Post Funding: An Unsustainable Approach

Historically, most governments have not taken much interest in ex ante management of natural disasters because of low perceived vulnerability levels and the fact that most severe hazards manifest themselves very infrequently. In addition to this cognitive failure, there has been a willingness on the part of the international community to provide post disaster funding for vulnerable countries exposed to catastrophic events. The World Bank alone has disbursed more than US$40 billion of emergency and reconstruction loans (ERL) over the last twenty years.

The availability of free or inexpensive post-disaster donor funding creates a moral hazard problem, whereby disaster prone countries become more dependent on aid and less likely to practice market-based risk transfer solutions, including use of global reinsurance. Indeed, given the cost of risk financing solutions offered by the private markets, it is rational for the developing countries to rely largely on inexpensive ex post grants and multilateral institutions post-emergency lending.

As a consequence of underdeveloped domestic insurance markets and the lack of risk awareness or economic incentives to engage in ex ante risk management, governments generally adopt reactive approaches to natural disasters, relying on domestic budgets, including diversion of resources from other projects, and on extensive financing from international donors. In fact, emergency funding for reconstruction from international donors has become a linchpin of some governments' strategies for funding disaster reconstruction which is often supplemented by emergency reconstruction lending programs from the World Bank and other multilateral development banks. In addition, it is usually hard for the donor community to credibly enforce any pledges to reduce ex post assistance if ex ante mitigation measures have not been implemented because of the overriding humanitarian considerations once a disaster occurs.

Ex post funding approaches are inefficient. The lack of advance planning and resource allocation prevents funds from being immediately available after a disaster. Multilateral assistance can take a long time to disburse. As a result, the adverse social and developmental impacts of disrupted economic activity are far greater due to the delayed response.

Ex post funding approaches are ineffective. Resource allocation after a disaster may be ad hoc. Resources may be targeted on bureaucratic or political considerations, rather than directed to those expenditures and investments that are most likely to restore economic activity promptly. The diversion of limited fiscal resources away from development projects, creating high economic and social value added, to politically motivated low net return purposes can have considerable opportunity costs and long term adverse economic effects.

Ex post funding approaches are insufficient. Most developing countries face ongoing fiscal constraints. The quantity of funds available for relief and reconstruction may be far off from what is needed, particularly in the aftermath of a disaster. This leaves a substantial resource gap.

A fundamental consequence of natural disasters is that they tend to have the greatest impact on the poor, usually located in rural area, who are affected most by these adverse events. Scarce multilateral resources, which could have been utilized for growth and poverty reduction goals, are thus diverted by catastrophes, or more precisely, by the lack of appropriate ex ante disaster risk financing strategies.

This does not mean however that ex post disaster funding from donors and international development banks cannot play an important role in the country's risk management strategy, but that over-reliance on this approach has major limitations in terms of efficiency, effectiveness, and sufficiency. The challenge is thus to build a comprehensive risk financing strategy where the role of market-based insurance and social programs are clearly defined. Having pre defined rules that are tied to premium payments or fee payments for social programs may also mitigate inequities that may occur when political decisions must be about how to destitute large sums of emergency disaster aid arriving well-after the disaster.

2.2.   *Country Agricultural Risk Management Model*

By ensuring that sufficient liquidity exists very soon after a disaster, modern funding approaches can help to speed recovery, ensure the scare government funds are well used and reduce the risk of moral hazard. In addition, catastrophe risk management can assist countries in the optimal allocation of risk in the economy, which may result in higher growth, better mitigation, and more effective poverty alleviation.

The approach advocated by the World Bank Insurance Practice Model is to develop risk funding solutions that would provide countries with strong incentives to engage in active risk management and thus overtime achieve significant reduction in their growing vulnerability and risk exposures. Such a major turnaround however would require linking, at least to some extent, donors' post-disaster rehabilitation and reconstruction grants and emergency loans major

development banks to progress achieved by countries in ex-ante catastrophe risk management. This approach also rests on the notion of leveraging the Bank's emergency funding with that of international reinsurance and capital markets. Only by combining the funding capacity of donor countries, development banks and global reinsurance and capital markets, would developing countries be in the position to adequately meet their demands for risk capital to fund economic losses inflicted by natural disasters.

In the larger industrial countries, losses from natural disasters are typically funded through a combination of private risk financing arrangements and an efficient public revenue system relying on wide and deep taxation catchments. In the case of developing countries, which have relatively low tax ratios and ongoing fiscal pressures, funding sources for post disaster reconstruction tend to be more varied, with a strong emphasis on assistance from international donors. Multilaterally sourced infrastructure loans and relief aid from donors agencies are among the most common sources of such disaster funding.

A number of developing countries exposed to natural disasters have a limited capacity to absorb economic shocks caused by such disasters, thus relying on external sources of funding. Due to agency and information problems, new external capital is usually more expensive than internal capital (Froot, Scharfstein and Stein 1993). These friction costs make the country risk averse to catastrophic events and increasing the value of ex ante risk management strategies.[3]

The World Bank Insurance Practice has been developing a country catastrophic risk management model for which is partly based on corporate risk management principles but also factors in key economic and social metrics such as government fiscal profiles, the living conditions of the poor, and investment in risk mitigation (Gurenko and Lester 2004). This risk management approach at the country level relies on the assessment of the country fiscal exposure when all the cost-effective risk mitigation measures have been implemented, the identification of potential funding gaps between damages sustained by the country and funds available, and the financing of these gaps through private capital markets, and World Bank lending instruments.

This framework has been extended to natural disasters in agriculture (Gurenko and Mahul 2004, Mahul 2005). It can be broken down in five main pillars.

Differentiating market-based insurance and social insurance. The inherent lack of clarity regarding the objectives of the public intervention in agricultural insurance has contributed to its inefficiencies. Social insurance, or safety-net, aims at assuring a minimum economic security to all farmers, and particularly those involved in low profitable activities. These social objectives rely on wealth transfer instruments. Market-based insurance is oriented toward viable business activities that generate enough profit to afford insurance premium. These instruments, which are based on sound actuarial principles, should apply only to viable farms whose survival may be jeopardized by the occurrence of an insured event.

Assessing agricultural production risks. The existence of reliable and accurate long-term loss data series is a precondition for the development of any market-based product, as they are used to assess the future probable losses. Individual farm data are almost always missing or unreliable. Consequently, loss assessment is usually performed using aggregate data. This analysis based on catastrophic risk modeling techniques provides objective estimates of potential losses and captures the spatial correlation of losses caused by widespread events (e.g., droughts, floods, epidemics). The following measures of loss can be estimated either from historical data or from losses simulated with probabilistic risk models:

- *Value at risk* is the total loss exposure of the assets at risk.

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[3] In a perfect market where external capital would not be more expensive than internal capital, i.e., in the absence of friction costs, risk management would be irrelevant.

- *Annual average loss* (AAL) is the expected loss per year when averaged over a long period of time.

- *Probable maximum loss* (PML) is the largest likely loss for a given return period, e.g., one in 50 year event (i.e., 2% frequency).

Financing agricultural production risks. Risk financing strategies deal with the remaining part of the risks that cannot be mitigated with cost-effective preventive measures. They are financed through farmers' self-retention, private financial markets, governments and international donors through an appropriate layering of risks (see Figure 1).

- The *bottom layer of risk* includes high frequency (e.g., occurring once every five years or more frequently) but low consequence risks that affect farmers from a variety of almost independent risks. In many cases, these losses are caused by inappropriate management decisions and are thus exposed to moral hazard and adverse selection problems. They must be retained by the farmers and financed by individual savings/credit.

- The *mezzanine layer of risk* includes less frequent (e.g., occurring once to six times every 30 years) but more severe risks that may affect several farmers at the same time (e.g., hail, frost). The private insurance industry has demonstrated its ability to cover these losses caused by localized adverse events and commercial farmers have shown their willingness to pay for named peril insurance.

- The *top layer of risk* includes low frequency (e.g., occurring once in 30 years or less frequently) but high severity risks. These catastrophic risks are by definition not well documented and the probable maximum loss can be very large. The cost of transferring these risks, i.e., the insurance premium, can be high compared to the annual average loss (e.g., five to ten times the AAL), making (re)insurance an inefficient risk financing mechanism. In addition, farmers may be unwilling to purchase this insurance because they tend to underestimate their exposure to catastrophic risks (cognitive failure) and rely on post disaster emergency relief. Governments usually cover these very infrequent losses through compulsory insurance programs or social disaster relief programs. Innovative financial products developed by capital markets, known as Alternative Risk Transfer (ART) instruments (e.g., catastrophe bonds, catastrophe options, contingent debt), may offer new risk transfer opportunities to the insurance markets and governments.

Figure 1. Agricultural production risk layering
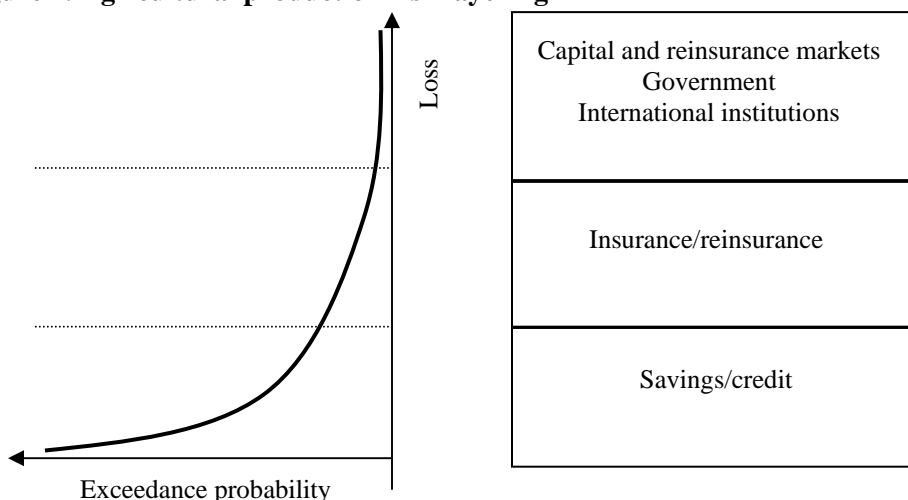
Source: authors.

Agricultural Insurance Pool. Agricultural insurance pools can contribute to offering affordable and effective insurance coverage through an efficient and low cost distribution mechanism that allows them to retain part of the agricultural risks in the country. They aim to act as a center of technical excellence to support insurers, ensure efficient local retention by pooling non-retainable risks, and get optimal pricing from reinsurers by providing a partly diversified portfolio. Self-insurance funds in Mexico (Fondos) offer a valuable illustration of these mutuality-type organizations among farmers (see Box 1). Catastrophe insurance pools have also been established to help domestic insurance companies finance catastrophic property losses (e.g., housing and infrastructure losses) caused by earthquakes, floods or cyclones, and to gain access to international reinsurance markets. The World Bank provided technical and financial support to the Government of Turkey for the creation of the first ever catastrophe insurance pool in middle income countries, the Turkish Catastrophe Insurance Pool (see Box 2).

Product Development. Index-based insurance is an alternative form of insurance that makes payments based on an index, irrespective of the individual losses. It allows the agricultural sector to transfer covariate production losses caused by widespread weather events (e.g., floods, droughts) or epidemics to financial and reinsurance markets. Index-based contracts offer advantages over traditional individual insurance (no moral hazard or adverse selection, low administrative costs, standardized product) but it exposes the contract buyer to imperfect indemnification, i.e., the possibility that the payout is different to the individual loss (basis risk), and relies on the quality of the data. Table 1 summarizes the main tradeoffs to be considered in the selection of an effective insurance index. Experiences in index-based insurance are multiple, but still remain marginal. Area yield crop insurance, where the index is based on the average yield in a given geographical area, has been offered in India, Brazil, Canada and the USA (Skees, et al. 1997). Parametric insurance (e.g., rainfall insurance) has been offered in Canada, Mexico and India. As described in the subsequent sections, a livestock mortality index will soon be offered for indemnifying herders in Mongolia.

Table 1. Index effectiveness

	Individual index	Area-based index	Parametric index
Easily comprehensible	Yes	Often	Yes
Basis risk	No	Yes	Yes
Delays in claim settlement	Sometimes	Yes	Rarely
Moral hazard/adverse selection	Yes	Sometimes	No
Reliable data	Rarely	Sometimes	Often
Index manipulation	Yes	Rarely	Sometimes
Administrative costs	High	Low	low

Source: authors.

Box 1. Fondos in Mexico

Fondos are self-insurance funds that have been operating in Mexico since 1988. In 2004, more than 240 Fondos provided insurance against agricultural production risks (including hail, drought, frost, floods, diseases, pests) to their members, accounting for 50 percent of the total insured agricultural area in Mexico. The total liability of the Fondos on an annual basis was approximately US$$400 million dollars in 2004. They are mainly concentrated in agricultural areas with productive potential and financial viability.

Subsistence and poor non-commercial farmers are supposed to be covered through the Government sponsored national disaster scheme FONDEN.

According to Mexican laws, Fondos are non-profit organizations constituted by the farmers as civil associations without the need to provide any capital endowment, except their willingness to associate between themselves. From a risk-financing perspective, Fondos pool crop yield risks from farmers with similar risk profiles. The concept of insurance through mutuality-type organizations was developed in Mexico based on a sound insurance market approach (including proper underwriting of risks based on technical principles, constitution and investment of adequate financial reserves, loss adjustment procedures based on technical guidelines and rates developed according to sound actuarial methodologies), while taking advantage of mutuality type organizational principles and structure of incentives to keep transaction costs under control.

The Fondos can not sell insurance to their members unless they have a proper reinsurance treaty negotiated before the beginning of any specific agricultural cycle of production. Since these organizations do not have capital to guarantee the solvency of the Fondos, they must buy enough reinsurance to guarantee that the members of the Fondo will receive the full amount of indemnity in the case of a peril (no default risk). The regulation requires that any reinsurance contract negotiated by the Fondos should be defined to absorb any exceeding indemnities after the financial reserves of the Fondos have been exhausted. Therefore, an unlimited stop loss reinsurance treaty is implicitly requested. Historically, the state-owned reinsurance company Agroasemex has offered to the Fondos this unlimited stop loss program. The Government supports also a training program to enhance the operations of the funds through Agroasemex. The training programs include technical aspects related to the underwriting and loss adjustment procedures, the development of new products, accounting, legal aspects, etc.

Source: Ibarra and Mahul (2004).

Box 2. Turkish Catastrophe Insurance Pool

In the aftermath of the August 1999 Marmara earthquake, The Turkish Government with the World Bank technical and financial support created the Turkish Catastrophe Insurance Pool (TCIP). The program operates as a catastrophic risk transfer and risk financing mechanism that limits the government's financial exposure to future natural disasters by absorbing up to UD$ 1 billion from Turkish homeowners. Under the program, compulsory earthquake cover is introduced for all property-tax paying dwellings.

The government aimed at creating a pool in which sufficient reserves could be accumulated over time, thus making Turkey less vulnerable to future earthquakes. The key objectives for the TCIP defined by the Government of Turkey were:

- Ensure that all property tax paying domestic dwellings have earthquake insurance coverage;

- Reduce government fiscal exposure to recurrent earthquake;

- Transfer catastrophic risk to the international reinsurance market;

- Encourage risk mitigation through the insurance mechanism.

The World Bank provided the initial capitalization of the TCIP through a committed contingent loan facility of US$100 million, extended to US$180 million in 2004. Although the risk capital requirements of TCIP are much higher, they are funded through of commercial reinsurance, in the amount of US$750 million, and the build-up of surplus. The disbursement of the Bank facility would be triggered by occurrence of a loss, as evidenced by insurance claims from a major earthquake. As of today, the line of credit remains undisbursed.

The TCIP's earthquake insurance is legally compulsory for many urban Turkish homeowners, although the compulsion is not well enforced. Local insurers act as distributors of the TCIP (they do not retain any fraction of the earthquake risk), in exchange of a commission (15-20% of written premium), and provide additional coverage in excess of that offered by the pool. Since its inception in 2000, the TCIP's penetration ratio has averaged 17%.

Source: Gurenko and Lester (2004)

2.3.   Policy Implications: Toward a Public-Private Partnership

Governments, with the help of international institutions like the World Bank, can create an economic and legal environment that facilitates the emergence of a competitive insurance market and provides farmers with incentives to engage in risk financing strategies. This should rely on a public-private partnership between the government and the domestic insurance industry to address the following challenges:

- *Data management*. An efficient data management system is critical to the development insurance products. It aims to (i) build accurate and complete historic database and (ii) secure future data measurements from fraud and abuse.

- *Regulatory and supervisory framework.* This framework is intended to ensure that (i) insurers have the financial resources required to pay all claims as they become due and (ii) insurers treat consumers in an equitable manner in all financial dealings. It is based on a set of rules that foster financial sector stability and public protection, while ensuring market competitiveness and efficiency.

- *Technical expertise.* Agricultural insurance is a very technical field. At the top administrative level, it requires expertise in the design of the insurance scheme, the establishment of the terms and conditions of coverage, and the actuarial aspects of insurance. At the local level, there is a need for personnel who can explain agricultural insurance to the farmers and for personnel skilled in the functions of underwriting and loss adjustment.

- *Risk financing entity.* Governments should only finance losses that cannot be transferred to the private market at acceptable costs. They should focus on catastrophic losses, acting as reinsurers of last resort, when the financial resources of the domestic insurance industry are scarce and the access to international reinsurance markets is limited. This temporary risk arrangement should allow insurance companies to build up reserves and to retain larger layers of risk over time. The resulting risk exposure of governments should be adequately financed through an appropriate country risk financing strategy including, e.g., reserve funds, reinsurance and contingent debt facilities provided by the international institutions like the World Bank.

- *Information and education*. Information and education campaigns should be undertaken to reduce the widespread lack of insurance culture among farmers.

3.   Livestock Mortality in Mongolia

3.1.   Mongolian Livestock Sector

The agricultural sector plays a central role in the Mongolian economy, contributing around one third of national GDP. The most important agricultural activity is livestock husbandry, which has over 80 percent share of agricultural GDP and supports at least half the population. Livestock provides an important source of income, jobs and food security, and a means for households to invest and store their wealth. However, the country is prone to regular extreme climatic events that can cause high rates of livestock mortality, jeopardizing rural livelihoods. In particular, the frequent droughts and severe winters (known as *dzuds*) can devastate herd numbers. During the period between 1999 and 2002, one third of the national herd was lost in successive *dzuds*.

The importance of livestock to the livelihoods of poor rural households has increased in recent years with the shift from collectivized farming to family-based herding during the 1990s. As a result of economic restructuring, the number of herding families doubled from 1990-1997, and

Mongolia's overall herd size increased from 25 to 31 million, increasing the pressure on grazing resources.

The Government of Mongolia has prioritized the livestock sector and, with support from donors, is responding to these disasters and introducing a program of sectoral reform. This includes greater flexibility in pasture land tenure, coupled with increased investment in rural infrastructure and services. A major thrust of government and donor intervention is the support for improved pastoral risk management. These sectoral reforms and approaches are not sufficient, however, in the face of catastrophic weather events. Although the State Reserves Agency works to mitigate the effects of *dzud,* when, due to extreme conditions, catastrophic livestock mortality arises there is no insurance. Herders have to rely upon traditional informal coping mechanisms and ad hoc support from Government and international agencies. For affected areas, after immediate relief the main longer term support has been through restocking programs. Evaluation has shown that these can be expensive, relatively inefficient and fail to provide the right incentives for herders. Finally, restocking during a period where animals and pasture conditions are poor can actually increase livestock mortality in the following year.

The management of risk in the livestock sector requires a combination of approaches. Pastoral risk mitigation can better prepare herders for moderate weather events. For *dzud* events, however, high levels of livestock mortality are often unavoidable even for the most experienced herders, and pastoral and herd management must be complemented by risk financing mechanisms that provide herders with instant liquidity in the aftermath of a disaster.

Livestock insurance is a key element of risk financing. However, the traditional individual livestock insurance (based on individual losses) has turned out to be ineffective in Mongolia: high loss adjustment costs due to the spread of animals among vast areas, ex ante moral hazard inducing herders failure to take all effective measures to protect their stock, ex post moral hazard leading herders to falsely report animal deaths are among the key endemic problems that plague traditional livestock insurance program in Mongolia. Monitoring individual herders in the vast territory of Mongolia is a nearly impossible task. Currently, the formal financial insurance products related to livestock mortality are unpopular among both insurance companies and livestock owners and are limited almost entirely to a small number of high value livestock.

3.2. *Livestock Losses*

After the livestock privatization in 1992, the number of livestock in Mongolia increased by 17.5% percent, reaching 33.6 million by 2000. In the period 2000-2002, over 11 million adult animals died due to severe droughts followed by harsh winters (*dzuds*). In 2004, the size of the Mongolian livestock herd was approximately 23 million. The composition by species was 45% sheep, 38% goats, 8% cattle, 8% horses and 1% camels.

Severe weather conditions expose the national livestock to high mortality rates. Figure 2 shows the total losses faced by herders in Mongolia over the period 1971-2004, as a percentage of the total livestock value and as a percentage of 2004 GDP, estimated at US$1.4 billion (World Bank 2005). Annual total losses are less than 8 percent of the total livestock until 1999, and even less than 4 percent over the period 1994-1999. The years 2000-2002 show a dramatic increase in losses, reaching US$ 140 million (12% of the total livestock value) in 2000, and almost US$ 200 million in 2001 (17% of the total livestock value). The animal husbandry industry in Mongolia is thus exposed to macro exogenous shocks caused by adverse weather events. Such variability has negative effects on the growth of this industry which contributes for one fourth of GDP and the economic growth of the country.

**Figure 2. Livestock losses in Mongolia, 1971-2004.**
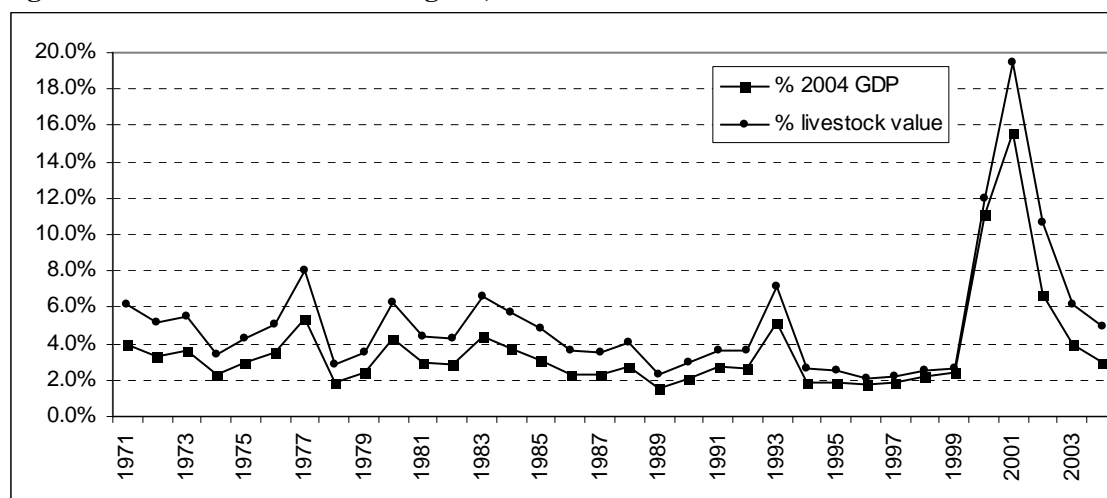
Source: National Statistics Office of Mongolia.

The analysis of hazard frequencies and intensities is critical to assess the country exposure to livestock losses. Risk assessment models provide a set of metrics, i.e., quantitative measurements of potential losses with respect to the frequency of the events. As shown in Table 2 and Figure 3, the value of the Mongolian livestock in 2004 is estimated at US$971 million. The average annual loss is US$ 46 million, i.e., 5 percent of the total value of the livestock and 3.3 percent of 2004 GDP. However, the annual loss is highly variable, as a direct consequence of infrequent natural disasters, with a standard deviation estimated at US$ 36 million. Once every five years, the annual livestock loss would be US$ 53 million and this estimation goes up to US$ 143 million for catastrophic events occurring once every 30 years.

Table 2. Livestock risk profile in Mongolia

	US$, million	Percentage of assets at risk	Percentage of 2004 GDP
Assets at risk (2004)	971	-	61.1%
Average annual loss	46	6.0%	3.7%
Standard deviation	36	4.6%	2.8%
PML (1 in 30 year event)	143	18.5%	11.3%
PML (1 in 20 year event)	107	13.9%	8.5%
PML (1 in 10 year event)	67	8.7%	5.3%
PML (1 in 5 year event)	53	6.8%	4.2%

Source: authors.

Figure 3. Livestock loss estimate - Exceedance probability curve.
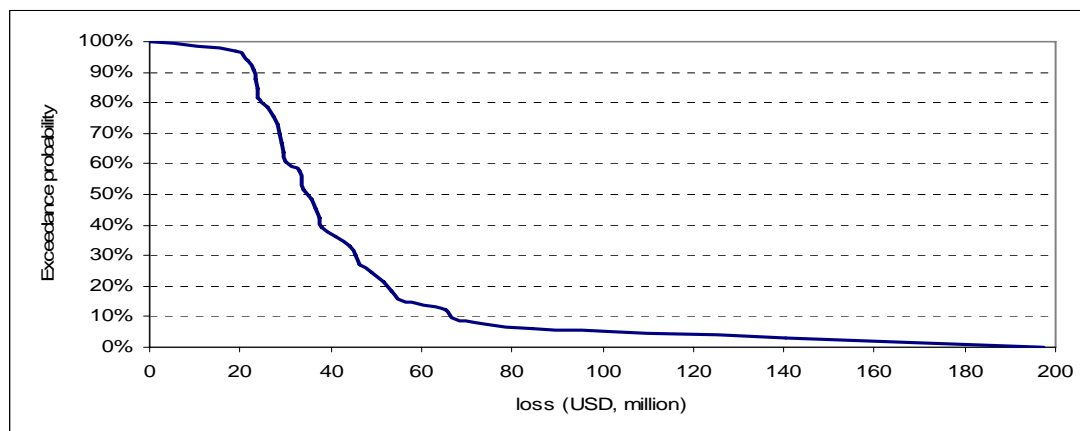
Source: authors.

3.3.   Livestock Mortality Rates

The Government of Mongolia has been conducting an annual census of adult animals (cattle, seep, goats, horses and camels) and the reporting of animal mortality for more than 50 years. This process is regulated by numerous laws (CPR, 2004). Mortality rates, defined as the ratio of losses of adult animals in a given year to the census of adult animals the previous year, can be calculated for each species at the *soum* level over the period 1971-2004. It is noteworthy that the losses of adult animals reflect all causes of loss, including diseases.

These mortality rates capture the heterogeneity of losses among the species and the geographic areas. Based on the 33 years and 324 soums, Table 3 presents some insights about the frequency of mortality rates (MR) by species. Cattle are more frequently exposed to minor losses (MR lower than 5%) and catastrophic losses (MR higher than 20%) than the other species.

Table 3. Frequency of mortality rate, by species

Morality rate	Cattle	Sheep	Goat	Horse	Camel
0% to 5%	72.9%	70.1%	71.7%	72.2%	64.0%
5% to 7.5%	10.6%	14.3%	12.8%	12.6%	17.3%
7.5% to 10%	4.9%	6.2%	5.8%	6.1%	8.4%
10% to 20%	6.5%	6.9%	7.3%	6.3%	9.2%
20% and more	5.2%	2.6%	2.5%	2.8%	1.1%

Source: authors.

The mortality rates also differ significantly by regions, as shown on Figure 4. They are higher in the Southern regions of Mongolia, near the Gobi desert, and in North-West part of the country.

Figure 4. Average livestock mortality rate by *soum*: 2000-2002
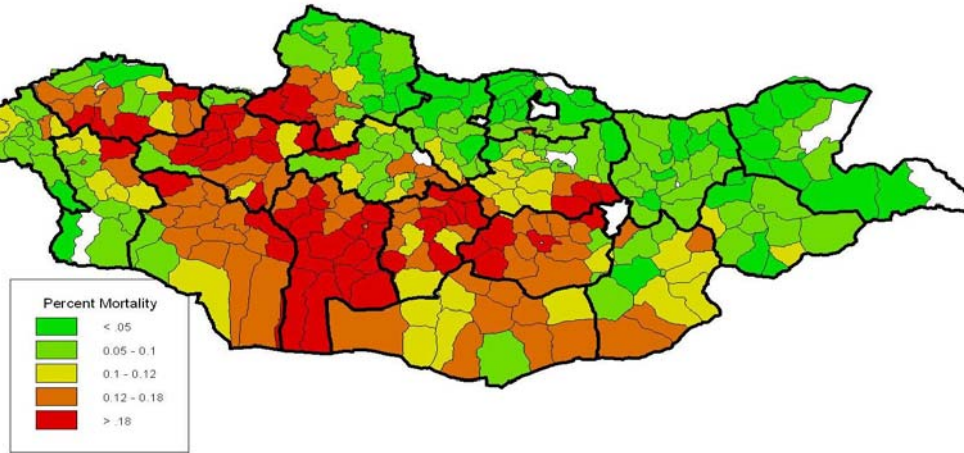
Note: Average livestock mortality rates for all species (camels, horses, cattle, sheep, goats) over the period 2000-2002.

Source: authors.

The mortality data present some unique problems in developing the underlying distribution function. Figure 5 illustrates the issue by presenting a frequency plot of mortality rates for cattle and yak from a sample soum. In this particular soum, there are five events out of the 33 years of data (1971-2004) with mortality rates in excess of 10 percent. Even though the maximum rate was 33 percent in this soum, there are many soums in the same aimag with mortality rates in excess of this level. The upper bound on mortality is still 100%. Distributions are heavily skewed to the right given the nature of this risk. Data in the upper ranges of mortality are rare. Sample size is quite limited to fit the range of events in the upper ranges of the data. There is ambiguity regarding what the probability of the upper range mortality rates actually are. There are no distribution fitting procedures that are likely to capture the underlying distribution of these risks. An alternative would be a mixed distribution, one distribution capturing non-catastrophic events (e.g., MR lower than 30 percent) and one distribution capturing catastrophic events.

Figure 5. Historic frequency of mortality rate, cattle, sample soum
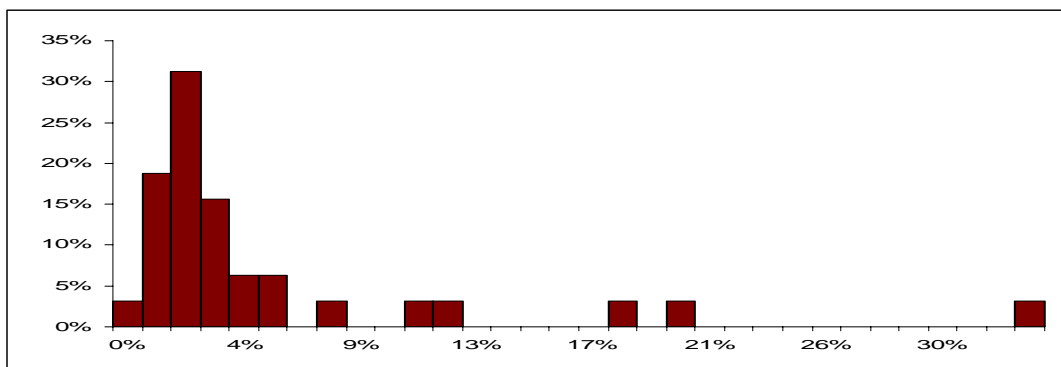
Source: authors.

4.   Designing a Livestock Insurance Program

4.1.   Index-based livestock insurance

Attempts to develop individual livestock insurance in Mongolia have been unsuccessful in recent years. This traditional form of insurance, where indemnities are calculated for each insured farmer on the basis of individual claims, simply cannot work in Mongolia because (i) individual historic data are not available and thus insurer cannot have adequate information on individual herders, creating classic moral hazard and adverse selection problems, (ii) collection of individual data would necessitate tremendous equipment and personnel investments in the vast geographic area of Mongolia, and (iii) individual loss adjustments would be very costly or nearly impossible.

An alternative approach is to develop a collective system for indemnifications: indemnity payments are based on an external index designed to reflect the loss incurred by the herders. Such schemes are known as index-based insurance. Area-yield insurance programs, where the index is the aggregate yield in a given geographical area, have been implemented in India and in the U.S. Weather-based insurance contracts, where the index is based on some weather parameters (e.g., rainfall, temperature) have been investigated in numerous countries and implemented in Canada and in India. These schemes present some advantages (e.g., reduction of moral hazard and adverse selection, lower administrative costs), but their main impediment is the presence of basis risk, i.e., the imperfect correlation between the insurance indemnity and the individual loss.

Weather-based insurance was considered as a first alternative to individual insurance because Mongolia has reasonable historical weather records to support the risk analysis. However, the infrastructure of the weather system is under-funded and has stations that are far apart, limiting the information needs required for weather-based insurance. Furthermore, winter *dzuds* are complex events, consisting of multiple weather phenomena over a period of time, and sometimes non-weather factors, making the classification of risk highly problematic.[4]

Skees and Enkh-Amgalan (2002) proposed to design an index-based insurance product that would indemnify herders based on the mortality rate of adult animals in a given area. The index-based livestock insurance (IBLI) would pay indemnities whenever the adult mortality rate exceeds a specific threshold for a localized region (e.g., the *soum* in Mongolia). It is simpler than weather-based insurance, and is less prone to moral hazards, adverse selection, and high administrative costs of individual insurance. Importantly, this system provides strong incentives to individual herders to continue to manage their herds so as to minimize the impacts of major *dzud* events (i.e., if a better herder has no losses when their neighbors has large losses, the better herder is rewarded for the extra effort by receiving a payment based on the area losses). Finally, a 33 year time series on adult animal mortality is available for all *soums* and for the five major species of animals. Such data are critical for developing actuarial information and for understanding the potential cost of alternative designs.

4.2.   Layering livestock risk

Previous government efforts to develop viable agricultural insurance programs in many developed countries and developing countries have been frustrated by the inherent lack of clarity regarding the objectives that range from social safety nets to commercial insurance. Governments start realizing that these programs are no longer financially sustainable. For example, the Government of India has recently decided to reform the current crop insurance scheme and to

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[4] Initial results showed a low correlation between livestock mortality rates and weather parameters (rainfall, minimum temperature, maximum temperature). However, options will be further considered for linking the index-based livestock insurance product to other indicators such as weather data and/or indices for range vegetation conditions (e.g. normalized, differentiated vegetation index – NDVI).

place it on an actuarial path.[5] Starting in 2006, premiums will be charged on a commercial basis and the Government's support would provide up front premium subsidies. Such a sound financial and actuarial approach aims to introduce more discipline in the program and to transfer catastrophic losses to the international reinsurance market.
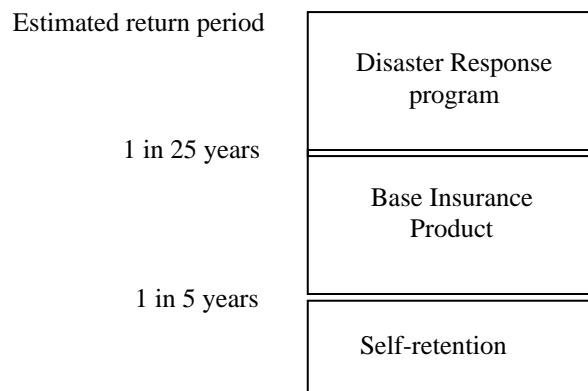
The government may have limited comparative advantage to reduce risk, compared to the private insurance industry (Priest 1996). The risk aggregation function, through the law of large numbers, performs well with relatively small sample when individual risks are independent. In this context, the government's size and scope is not required for the risk aggregation function to perform well. Insurers control adverse selection by segregating the individual risks. Low insurance premiums are offered to low-risk producers, while higher premiums are charged to high-risk producers as a signal of their true risk exposure. The insurance industry thus plays a central role in discovering the true cost of risk. However, segregation is often viewed as socially unacceptable because it does not meet some social and solidarity objectives. As a consequence, public insurance is likely to engage low efforts to control adverse selection through risk pool segregation and to offer some average premium to all parties. Under voluntary insurance, this absence of segregation leads to the death spiral of adverse selection. In this case, compulsory insurance may be viewed as a solution to adverse selection as it forces low-risk producers to stay in the insurance pool. However, this is not a risk reducing effect but a wealth redistribution effect from the low-risk agents, who over-pay their premiums, to the high-risk agents, who under-pay their premiums. The ex ante control of moral hazard is based on risk sharing through coinsurance and deductibles, and exclusions on insurance coverage. This limited coverage is usually inconsistent with the government's willingness to offer farmers universal coverage against all sources of risk. As in the case of adverse selection, social objectives may prevent the government from controlling efficiently moral hazard problems. However, the government may have a comparative advantage to absorb catastrophic losses that are beyond the financial capacity of the insurance industry because it is able to spread these losses across generations and to implement the solidarity principle through an appropriate wealth transfer mechanism.

The dual goals of providing commercial insurance in the private insurance sector and social insurance in the public sector are addressed through the following layering of livestock risk (see Figure 6).

- High frequency but low severity losses, occurring approximately once every five years or more frequently, are retained by the herders and managed through risk mitigation activities or individual capital (e.g., savings, credit).

- Less frequent but more severe losses, occurring approximately once every 5 to 25 years, are financed by a commercial insurance product, *Base Insurance Product* (BIP). This product covers the mezzanine layer of risk. Herders pay premiums priced at commercial rates, i.e., including the risk load premium and the operating costs. This product is sold on a voluntary basis.

- Catastrophic losses, occurring approximately once every 25 years or more, are covered by a social safety-net product, *Disaster Response Product* (DRP). This social product complements the commercial product. The rationale for this top layer of risk is that the domestic insurance industry in Mongolia could not retain such catastrophic losses and could not transfer it out of the country because of the lack of access to international reinsurance and capital markets. Therefore the government acts as an insurer of last resort for this top layer of risk.

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[5] The National Agriculture Insurance Scheme in India is the largest crop insurance program worldwide in terms of insured farmers, with approximately 17 million in 2005.

Figure 6. Livestock Risk Layering

Estimated return period

	Disaster Response program
1 in 25 years	
	Base Insurance Product
1 in 5 years	
	Self-retention

Source: authors.

BIP and DRP payments are based on the *soum* mortality rate, as reported by the National Statistical Office of the Government of Mongolia. The attachment point (strike) and the exhaustion point (cap) of the BIP are set according to the estimated return of period mentioned above. Therefore, the attachment points should vary from 7% to 10% depending on the species and the soums and the exhaustion points should vary from 25% to 30%. In the proposed insurance policy to be pilot tested, only one strike at 7% and two caps at 25 or 30% are offered to the herders for the sake of simplicity, but it is expected that at least two strikes (7% and 10%) will be proposed to the herders in the near future. Box 3 describes how BIP and DRP work.

Box 3. How BIP and DRP work

Herders pay a premium based on the value of their animals reported and the relative risk in the soum that they select. The soum is selected based on herder knowledge of where his animals are most exposed during the year. Herders are able to insure between 25 and 100 percent of estimated value of their animals. Payments begin once the predetermined threshold of mortality for the soum (strike) and species is exceeded. The payment rate is capped once the mortality rate exceeds the exhaustion point (cap). BIP payments are the product of the payment rate times the value insured. Formally, the BIP indemnity schedule is

$$I^{BIP}(MR) = (\text{sum insured}) \times \min\{\max[MR - strike, 0], cap - strike\},$$ where MR is the reported mortality rate.

DRP payments use the full value of animals as the base of value insured. The DRP pay for losses beyond the exhaustion point. Formally, the DRP indemnity schedule is

$$I^{DRP}(MR) = (\text{value of animals}) \times \max[MR - cap, 0].$$

As an example, consider a herder who has 36 sheep where the value of a sheep is 28,320 Tg. The herder decides to insure the total value = 28,320 Tg. x 36 ~ 1,000,000 Tg. The premium rate for the BIP, with a strike at 7% and a cap at 30%, is 1.4 %. The herder would pay 1.4 x .01 x 1,000,000 = 14,000 Tg.

The mortality rate in the herder's *soum* during a bad *dzud* year equals 35 %. Payment rate for the BIP is equal to 30% -7% = 23 %, and thus BIP are 23% x 1,000,000 Tg. = 230,000 Tg. Payment for the DRP equals (35% - 30%) x 1,000,000 Tg. = 50,000 Tg.

Source: Authors.

4.3.   Livestock Insurance Indemnity Pool

Despite this layering of livestock risk that transfers the top layer to the government through a social insurance product, the domestic insurance industry in Mongolia is still exposed to significant losses through the commercial product BIP due to high spatial correlation of mortality for events in the 7 to 25 or 30% levels.

The Mongolian insurance market is underdeveloped and the regulatory and supervisory body is not effective (see Box 4). A new Law on Insurance, enacted in April 2004, came into effect on 1st January 2005. However, it is expected that the new Financial Regulatory Committee (FRC) will not be fully effective in the supervision of the insurance sector for some years. This is especially true in the case of a catastrophic insurance offering such as index-based livestock insurance. Therefore, it is unlikely that the FRC will be fully positioned or prepared to regulate and supervise the IBLI product in the near future. As a consequence, it became necessary to devise a separate and possibly temporary arrangement to market the IBLI product. The proposed arrangement is based on a contractual agreement between the participating insurance companies and the Government of Mongolia under which the livestock insurance business is considered as a specific class of business and consequently managed with specific rules. The unique characteristics of this line of business compared to other lines of property insurance are twofold. First, IBLI is exposed to catastrophic risks, mainly caused by harsh winters (*dzuds*), and thus needs appropriate risk financing. Second, this new line of business is in a pilot stage, with all uncertainty associated with the launch of an innovative product. Early ring-fencing of the livestock business would thus protect it from excessive losses in other classes (the reverse issue is less relevant given the small initial volumes involved). A Livestock Insurance Indemnity Pool (LIIP) is established. The key objectives to be achieved through this annual insurance pool are the following:

- Herders must receive in full the indemnity payments that are due – no default risk;
- A simple and stable structure for implementation in the short run that allows for flexibility in the future;
- Incentives for companies to sell the IBLI product;
- The insurance industry is insulated from catastrophic livestock losses;
- Incentives for companies to collaborate on the integrity of the system;
- The foundation is consistent with a new regulatory environment.

Box 4. Domestic insurance market in Mongolia.

The domestic insurance market is immature and undercapitalized. It was open to the competition in the early 1990s, and the two state-owned insurance companies, Mongol Daatgal and Tushig were privatized in 2004. As of December 2004, 24 insurance companies are licensed and offer non-life insurance only (personal accident, property and liability).

The 2004 annual gross premium volume was US$5.3 million, of which 61 percent was for property insurance (including aircraft insurance of the Mongolian airline MIAT for 25 percent), 30 percent was for liability insurance (including aircraft liability insurance for 15 percent) and 9 percent was for personal accident and health insurance. The total premium of individual livestock insurance and crop insurance accounted for 0.5 percent of the gross premiums.

In 2004, the net income premium (gross income minus reinsurance premiums paid) was US$3.1 million. The premium volume represents 0.44 percent of Mongolian GDP and US$2.3 per capita. As a comparison, the insurance penetration, as a percent of GDP, is 0.57% in Vietnam, 0.61% in Philippine, 1.03 % in China, and 2.13% in Russia.

The domestic insurance market is highly concentrated with the first largest company, Mongol Daatgal, having a market share of 74%, and the three largest companies capturing 82% of the market shares.

In non-life insurance, the combined ratio is a standard measure of profitability used in the industry and by supervisors. It represents the profits or losses made on insurance operations, without the help of other income (e.g., investments, real estate, capital gains). The ratio is the total of the loss ratio, which represents the percentage of the claims paid in comparison with gross premiums, and the expense ratio, which is the percentage of the general expenses in comparison to the gross premiums. Insurance companies will normally have a combined ratio of over 100%, meaning that they experienced a technical loss, as claims and expenses exceeded premiums. However, other sources of income usually transform this loss into profit. Insurance companies are aiming at a ratio that is as close as possible to 100%, expecting investment income to compensate for technical losses. A ratio of less than 100% is remarkable, as it allows the insurance company to have a technical profit in addition to the investment profit. The combined ratio for the Mongolian (non life) insurance companies was at 56%. While the expense ratio of 34 percent is to those of insurance companies in most countries, the loss ratio is remarkably low. Such a low loss ratio may be due to over priced insurance policies and/or, more probably, by a low level of reported claims.

Source: Authors, from Mongolian Insurance Supervisory Agency (2004)

The syndicate pooling arrangement LIIP can be viewed as a joint venture established every year in which participating insurers subscribe capital. Insurance companies are given rights to sell the developed BIP product in exchange for their capital contributions. They are obligated to build up annual collective reserves into the LIIP at the beginning of the sales season. The GoM offers a stop loss reinsurance contract beyond the collective reserves, sold at an actuarially fair premium that is tied to the distribution of sales for each company.[6] In the initial years, a stop loss reinsurance treaty at 105 percent of the insurance premium volume (excluding operating costs) is in place. Funding for losses beyond 105 comes from the reinsurance premiums and a contingent loan from the World Bank.

In February of each sales season (starting in 2006), the participating insurance companies present a business plan with the expected sales by soum. They also deposit into the LIIP the guarantee indemnity contribution (GIC), which equates the insurer's expected portfolio reinsurance cost plus 5% of its expected written premium volume. This contribution represents their capital investment into this insurance program. After the sale closing date, they will deposit into the LIIP the herders' premium volume, out of which the LIIP will pay the reinsurance cost of the 105% stop loss on the collective livestock losses. At the end of the insurance cycle, any surplus (in addition to the interest earnings) in the LIIP account will be distributed among the participating insurance companies based upon their premium volume brought to the pool.

The reinsurance premiums paid by the insurance companies to the GoM will be put into special reserve fund, BIP reserves, and will be only used to pay reinsurance indemnities. The reinsurance premium paid by the LIIP to the Government, and deposited in the BIP reserve, may be higher than the actuarially fair reinsurance premium of the IBLI portfolio because of the pooling effect. Therefore, the reinsurance premium may be higher than the expected reinsurance payout, allowing the government to build reserves across time.

The reinsurance agreement between the insurance pool and the government is designed to give the insurance industry time to find external capital on the reinsurance market. Although it is not expected that international reinsurers will offer such an unlimited coverage, they may offer a

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[6] The Government should behave as a risk neutral decision maker as long as the cost of risk bearing is insignificant because it can be spread among a large number of taxpayers (Arrow and Lind, 1970). In the case of livestock insurance in Mongolia, this assumption may not hold as the Mongolian economy and the government fiscal revenue are negatively impacted by *dzud* events. However, during the pilot phase, excessive losses are financed by a World Bank contingent debt facility provided at a cost well below the market costs. This allows the Government to spread potential losses across time, thus reducing its aversion towards livestock losses.

layer of reinsurance, e.g., between 105% and 200% of premiums, and thus the Government's stop loss would only cover the losses exceeding this layer. Reinsurance companies may also be interested to take a share of the losses under the stop loss, e.g., through of a quota share agreement with participating insurance companies. Figure 7 depicts the risk financing arrangements for the BIP losses.

Figure 7. The financing of BIP losses under the LIIP.

Other Government Resources	Gvt Financed From Gvt budget and/or World Bank contingent loan	
BIP Reserves	Reinsurance premiums paid by insurance companies	} Herders' insurance premiums
LIIP Reserves (equal to 105 percent of herder premiums)	Herders' insurance premiums net of reinsurance costs	
	Guarantee Indemnity Contribution Fund	} Insurers' capital at risk
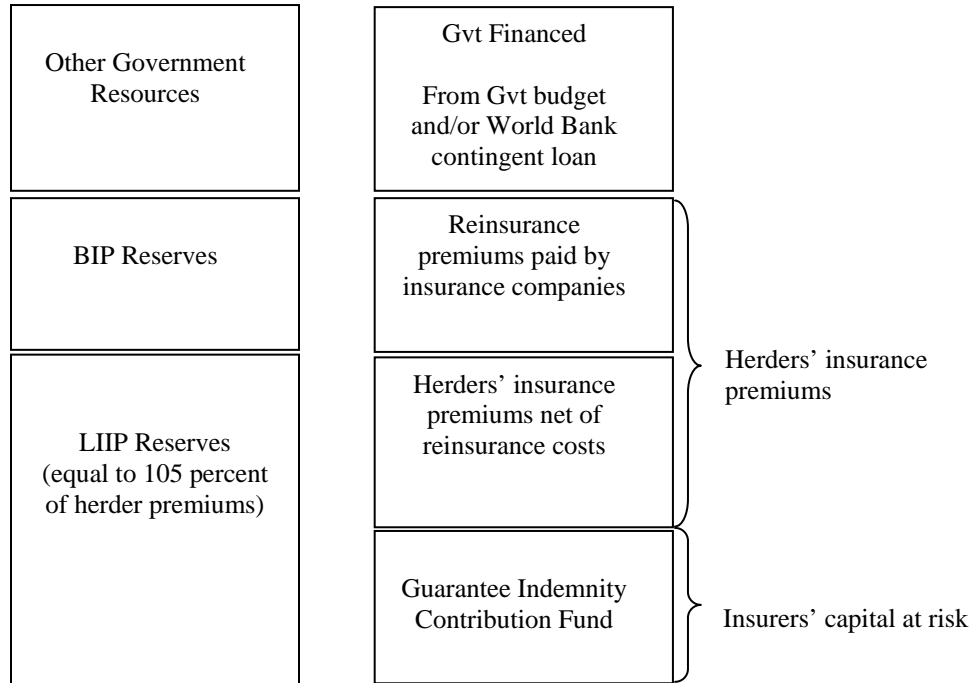
Source: Authors.

The LIIP is a unique syndicate pooling arrangement which has been designed to address the current constraints in the local insurance market in Mongolia: lack of capital of the domestic insurance industry, lack of access to the reinsurance market, weak regulatory and supervisory framework, and potential catastrophic livestock losses. It paves the way to the development of a more traditional pool where local insurers would build reserves over years to absorb moderate losses and transfer catastrophic losses to the reinsurance market to reduce the government's fiscal exposure to livestock losses.

While the collective action problem of high transaction costs and lack of trust plague many attempts to develop a pooling arrangement, these problems are largely linked to the legitimate concerns that an individual insurance company may have about the way that other insurance companies underwrite their risk. In this situation, all insurance companies are underwriting the same insurance contracts and each company is collecting premiums from herders that are based on the same procedures. Companies deposit the risk-loaded premiums into the LIIP. Thus, the uniformity of the contracts and the risk pricing should greatly reduce the transaction costs of agreeing to participate in a pooling arrangement. This is an extremely important aspect of pooling an index insurance contract versus attempting to pool traditional insurance products that will undoubtedly be more heterogeneous.

4.4.   Government fiscal exposure

The Government of Mongolia is double exposed to livestock risk under this livestock insurance program. First, it covers losses exceeding a specific threshold (e.g., 25-30% of livestock mortality rate) through the DRP. Second, it acts as a reinsurer of last resort for the insurance companies selling the BIP through a stop loss reinsurance treaty sold at a fair price to the LIIP. This double exposure needs to be adequately financed in order to avoid an increase in the fiscal burden of the Government of Mongolia.[7]

The proposed financing of the Government's potential losses relies on a combination of reserves and an IDA contingent credit provided by the World Bank. The BIP reserve includes reinsurance premiums paid by participating insurers and eventually additional capital brought by the GoM. Once this reserve is depleted, the Government will call the contingent debt facility. This facility can potentially provide the Government with a lower cost capital relative to the accumulation of reserves, but the major disadvantage is that once disbursed this facility could exacerbate the debt burden of the country. The effectiveness of this facility would thus depend on the country's post-disaster financial profile and more specifically on its post-disaster ability to service debt. A grace period of several years may allow the Government to recover an acceptable fiscal situation before starting to reimburse the contingent debt.

The disbursement of the contingent loan would follow the following process. If the actual BIP losses are in excess of the LIIP reserve and the BIP reserve and/or if DRP payments have to be made, then the contingent loan will be drawn down to cover these excess BIP losses and/or the DRP losses.

5.   Pilot Study

Based on several technical criteria (e.g., geographical spread of risk, existing pastoral risk management programs), three *aimags* have been selected for the pilot phase of this program: Bayankhongor, Uvs and Khentii (see Figure 8). The risk profiles are summarized in Annex 1. The value at risk, i.e., the total value of animals exposed to natural disasters, is estimated at $55 million in Khentii, $43 million in Uvs and $33 million in Bayankhongor. The average annual loss, based on the losses over the last 33 years, is estimated at $3.2 million in Khentii, $1.5 million in Uvs and $1.9 million in Bayankhongor. Given the catastrophic risk profile of the mortality rates cased by the occurrence of *dzuds*, the variability of the annual loss is high, particularly in Bayankhongor where the standard deviation is higher than the average. The average annual loss, in percentage of the value at risk, is estimated at 5.7 percent in Khentii, 4.7 percent in Uvs and 5.6 percent in Bayankhongor.

The historical morality rates are analyzed for the species at the aimag level to determine the relationship between species. A simple linear correlation is conducted for all pairs of species within each of the three aimags (see Table 4). They show positive correlations between the different species. Bankhongor has the most strongly correlated mortality rates. These coefficients of correlation are weaker in Khentii, particularly between sheep and cattle.

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[7] During the pilot phase, the Government may also have to provide ex post disaster relief in the area hit by a catastrophe and where livestock insurance is not offered.

Figure 8.   Selected areas for the IBLI pilot program.
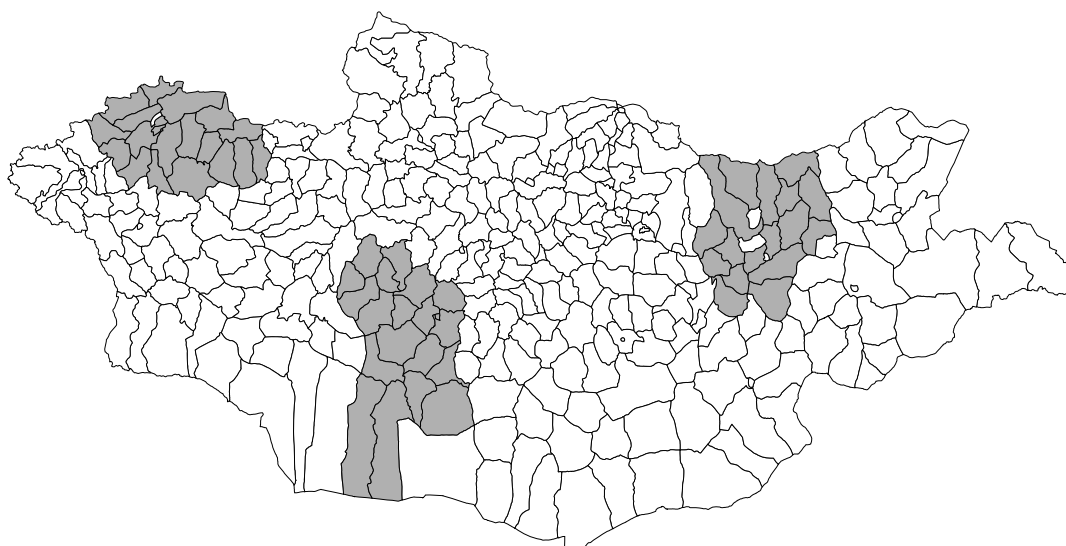
Source: Authors.

Table 4. Aimag correlation of mortality rates[8]

Aimag	Species	Cattle	Sheep	Horse	Goat
Bayankhongor	Cattle	1.00			
	Sheep	0.87	1.00		
	Horse	0.92	0.83	1.00	
	Goat	0.92	0.94	0.87	1.00
Khentii	Cattle	1.00			
	Sheep	0.35	1.00		
	Horse	0.51	0.62	1.00	
	Goat	0.91	0.94	0.87	1.00
Uvs	Cattle	1.00			
	Sheep	0.62	1.00		
	Horse	0.86	0.66	1.00	
	Goat	0.72	0.90	0.76	1.00

Source: AFSC 2004.

The size of the animal population varies greatly between species within a *soum.* Low data make mortality rates less credible, i.e., the mortality rates and their variability can be questioned. A potential consequence would be to provide over-payments or under-payments, thus increasing the potential dissatisfaction with the BIP program, either on the part of the insured herders or the private insurance providers. The limited credibility fluctuation approach is performed to identify the minimum number of animals under which the data are not credible and thus cannot be safely

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[8] Numbers are higher when the credibility criteria apples to eliminate soums with small number of animals.

used to base payments on (see Box 5). The threshold of 3,000 animal heads is selected. A proxy is used for the *soums* having less than 3,000 animals of a specific species. Given this criterion, cattle are excluded in 17% of soums and horses are excluded in 19% of soums. This represents only 6% of cattle and 11% of horses in all three aimags. Sheep morality rates are used as the proxy to make BIP and DRP payments when cattle and horses fall below 3,000 in any *soum.*

Box 5. Data credibility

The limited fluctuation credibility approach assumes that the random mortality for a particular soum-species follows a Poisson process in each year. We want to be sure that the observed mortality for a particular soum-species-year, *M*, is within *c*% of the true expected mortality, *m*, with probability (1-*a*)%:

$$\text{Prob}\big[(1-c)m \le M \le (1+c)m\big]=1-a \, .$$

Applying the central limit theorem, one can show that the expected mortality for soum-species-year *m* has to be greater than Z_a / c^2, where Z_a is the (a/2)th percentile of the normal distribution.

The average mortality for soum-species is 4.8% or above in 90% of soums. We would like to be very sure (99% sure) that the mortality rate estimate is within 1 percentage point of the true value, i.e., c=21% (=1%/0.048). Given a=1% and c=21%, we have $Z_a / c^2 = 151$. The minimum number of animals is thus 3,146=151/0.048, which is rounded at 3,000.

The species in a soum with less than 3,000 animals are considered to have low data and thus cannot be used to make indemnity payments because of their low credibility. This threshold excludes cattle in 17 soums and horses in 19 soums, out of 57 soums. This represents 6% of cattle and 11% and horses in all three selected aimags.

Source: Authors, from AFSC (2004).

The premium rates of the BIP product are calculated for each of the 59 *soums* in the three pilot *aimags* and for each species (cattle, sheep, goats and horses). The steps in the ratemaking procedure are detailed in Box 6. The weighted average premium rates, and the minimum and maximum premiums rates, by *aimag* and species, are listed in Table 5. Bayankhongor is the riskier *aimag* in this mezzanine layer of risk, with average premium rates and the minimum and maximum rates higher than those in the other *aimags*, for all four species.

Box 6. BIP ratemaking procedure

The main steps in setting the premium rates for the BIP program are the following.

First, the expected value of mortality rates exceeding 7% is computed for each soum-species.

Second, each aimag is divided into 3 risk zones using a pure premium rate for the commingled species (i.e., the sum of all deaths of all species divided by the soum of all animals for all species).

Third, the expected BIP payoff, i.e., mortality rates between 7% and 25%-30%, is computed for soum-species and zone-species.

Fourth, as a means of smoothing the premium rates out within a risk zone, the pure premium for a soum-species is then defined as the simple average between the expected BIP payoff for the soum-species and the expected BIP payoff for the zone-species, with the corresponding zone of the given soum.

Fifth, in order to account for the most extreme events in the region, a catastrophe load is added to the above pure premium. This catastrophe load is the simple average between the expected DRP payoff for the zone-species and the expected DRP payoff for the aimag-species, with the corresponding aimag of a given zone. These values are simply added to the premium rates that come from step 4.

Finally, the smoothed premium (equal to the pure premium from step 4 plus the catastrophe load) is weighted by a scale factor, determined at the aimag level, such that the reinsurance premium rate is roughly identical in all three aimags (about 38%). This last step aims to prevent participating insurance companies from targeting herders only located in the aimag with the lowest reinsurance cost.

Source: Authors.

Table 5. BIP loaded premium rates, weighted average by aimag.

	Goat	Horse	Sheep	Cattle
Uvs				
Average	1.05%	1.50%	0.83%	1.50%
Min	0.62%	0.50%	0.50%	0.68%
Max	1.86%	3.22%	1.98%	2.48%
Bayankhongor				
Average	2.33%	2.24%	2.59%	2.46%
Min	1.64%	1.50%	1.84%	2.07%
Max	2.76%	2.88%	2.99%	3.57%
Khentii				
Average	1.20%	0.94%	1.07%	1.69%
Min	0.85%	0.55%	0.76%	1.20%
Max	1.74%	1.96%	1.53%	2.18%

Source: authors.

The livestock loss exposure of the participating insurance companies is estimated under the following assumptions. Four insurance companies sell the IBLI product in the three pilot *aimags* and the total livestock insurance penetration rate is assumed to be 10 percent.[9] Three of them are concentrated in each of the three pilot *aimags*, with a penetration rate of 4 percent in each soum and each species. The fourth insurance company dominates the market and has a diversified portfolio with a penetration rate of 6 percent in the three aimags for all species. This roughly replicates the current insurance market shares in Mongolia.

Herders

Under such assumptions, historical data show that the probability of getting BIP payments in any given year is equal to 94% in Bayankhongor, 85% in Khentii and 70% in Uvs. The probability of receiving BIP payments higher than 10% of the risk-loaded premium is estimated at 61% in Bahnakhongor, 42% in Khentii and 27% in Uvs. Thus, there is a significant chance that some herders will get paid within the first year of implementation; such early payments would contribute to the credibility of the insurance program.

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[9] Given the international experience on the introduction of new agricultural insurance products, it is likely that the participation rate will not exceed 10 percent in the first years.

Herders subscribing only the DRP program have a lower probability of receiving any payments, as this program covers only extreme losses. The probability that DRP payments will be made in the pilot *aimags* in any given year is estimated at 30%.

Insurance industry

Under the assumption of 10% signup rates for BIP, the total premium volume (excluding operating costs) would be around $215,000. Since the reinsurance stop loss is 105 of total premium in the first year of implementation, the LIIP reserve would be about $276,000. The reinsurance premium rate is equal to 40% for the non-diversified portfolio, i.e., companies A, B and C, and 32% for the diversified portfolio of company D. The diversification effect thus allows company D to reduce the cost of reinsurance by 8 percentage points. This gives a strong incentive to participating insurers to bring a diversified portfolio of business to the pool.[10] Total reinsurance costs for the stop loss at 105 percent would be close to $50,000 (see Annex 2).

The average annual BIP loss paid by the LIIP is estimated at $133,000. The LIIP reserve would be fully depleted in about once every seven years (15%). The return on capital (ROC), including interest earnings at 13%, of the participating insurance companies would be high to reward the high risk exposure. The average ROC would be equal to 72-73% for the non-diversified companies and 119% for the diversified company. The insurance companies would lose their initial contribution about one every 4 years (24%).[11] Non-diversified companies would have a 58% chance of making 100% profit or more. This goes up to 62% for the diversified company (see Annex 2).

Government

The Government plays a key role in the proposed index-based livestock insurance program. First, it retains catastrophic livestock losses for all DRP signup when the mortality rates exceed a pre-defined threshold (25% of mortality rate in Khentii and 30% of mortality rate for Uvs and Bahnakhongor). This social device protects herders against extreme losses. Second, it acts as a reinsurer of last resort, providing an actuarially fair stop loss to the insurance pool when the LIIP reserves are exhausted.

The BIP reserve (equal to the reinsurance premium volume) would be about $50,000. As long as no large livestock losses occur, BIP reserve could be built up over time, increasing the financial capacity of the government to absorb large livestock losses. However, there would be a 20% chance that this reserve is not sufficient to cover all BIP reinsurance indemnities the first year of implementation (see Annex 3).

The special account, set up to fund the IDA contingent facility, would be used to finance BIP losses in excess of the BIP reserve and any DRP payments that the GoM is not able to finance through budget reallocation. Under the assumptions of this study, this special account would be used about once every 4 years (28%). There would be a 16% chance that the payments from this account exceed US$0.5 million, a 8% chance that the payments exceed US$1 million and a 2% chance that payments are higher than US$2 million (see Annex 3).

For this pilot and the assumptions regarding participation, the occurrence of three consecutive *dzuds* as those observed in 2000, 2001 and 2002 would cost to the Government about $3.8 million (see Annex 3). Given such estimates, the US$5 million contingent debt should be

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[10] However, the optimal strategy will be based on the tradeoff between the costs of setting up a delivery network in the aimags and the diversification gains.

[11] Even in those years, they will still make interest earnings on both their initial contribution and the herders' premium fraction that remains in the LIIP.

sufficient for financing losses from both the BIP and the DRP during the three year life of the pilot.

6.   Implementing and Operating the Pilot Project: Challenges

As this project is innovative and untested, there are potential problems that have influenced the design of the pilot. The special structure to both ring-fence other lines of insurance from BIP losses and to finance extreme losses have been addressed. Other concerns include statistics used to measure livestock mortality, basis risk for individual herders, lack of education and knowledge about index insurance among herders, potential for fraud in the country side.

6.1.   Statistics used to measure livestock mortality

The GoM has been conducting an annual census of animals in Mongolia for well over 50 years. The procedures are well-established and have numerous laws that attempt to protect the integrity of the process. Nonetheless, there are potential problems with these data once an insurance product is developed to pay based on the mortality rates. Considerable effort was made to understand the data process during the development of the pilot. It was learned that approximately 90 percent of the losses occur while herders are in their winter camps. Even though herders move their animals and can cross *soum* boundaries, it was also learned that where they have their winter camp is the designated *soum* in the census. Herders typically have a pattern of keeping their animals in the same camps by season. Local government leaders know the families and know their animals. These experts are used to assist in counting and reporting problems. New systems to track the same families will be developed at the National Statistics Office (NSO).

To assure a timely payment, a new animal census will be conducted during the pilot during the month of May. Mortality rates of adult animals will be based on the Census at the end of December and the May Census. There are very few animals slaughtered during this period. Thus, this statistic should reflect actual mortality better than numbers that would extend into the heavy slaughtering periods. During the pilot, the traditional methods of reporting mortality and a sample survey will be used to monitor any emerging problems. Additionally, a special technical assistance is beginning from the U.S. Department of Agriculture Statistics Service. This assistance will be targeted at a lower cost and more accurate procedure that will use sample survey techniques. At the end of the pilot, an evaluation will be made about the sustainability and reliability of alternative methods for estimating mortality rates.

6.2.   Basis Risk for Individual Herders

Basis risk will be an issue for some herders. Undoubtedly some herders will have losses when the mortality rate does not trigger a payment. To the extent that these losses are not severe when the insured herder does not get a payment or receives too little payment from the BIP or the DRP, the concept of self-retention is still important. However, there are potential problems if there are large losses. Other risk coping mechanisms need to be enhanced. Given that the index insurance should take the big risk out of the system, it can also allow groups of herders to share risk in more creative ways. The project will attempt to link the index insurance to microfinance and to herder self-help groups who could facilitate informal risk sharing mechanisms within the group (see Gurenko and Mahul (2004); Skees (2004)).

A relatively straightforward examination of the data confirms that the spatial relationships among contiguous *soums* are relatively high. The three worst years in recent history, 2000, 2001 and 2002 for three aimags, Khentii, Bayankhongor, and Uvs were examined to make this determination. The average mortality rate for each species for each aimag was calculated from the

soum mortality rates for a given year. Then the deviation from the mean was calculated for each soum as follows:

Deviation by *soum* = (*Soum* mortality rate - average *aimag* mortality rate)

Positive values indicate above average mortality rates for that *soum*, while negative values indicate below average mortality rates. These values were then mapped to get a visual representation of the geographic distribution of livestock deaths by species and soum. While there will be always be variation at the local level, the images indicate that the severity of the disaster is graduated, meaning the highest mortality rates are concentrated in several soums and decrease as you move further from that area. Though the index will be based on soum-level losses, the graduation of losses across soums indicates an event where there are correlated losses. This also is likely to be true within the soum. The higher the correlation of losses across an area, the more the index will match the loss experience of individual herders. Since sheep are the major species, the 2001 map for sheep is presented on Figure 9.

Figure 9. Soum Deviations from Aimag Average for Sheep in 2001

2001 sheep mortality

soum mortality rates
deviation from average

███	20-43%
███	5 - 20%
▓▓▓	(-5) - 5%
☐	(-16) - (-5)%
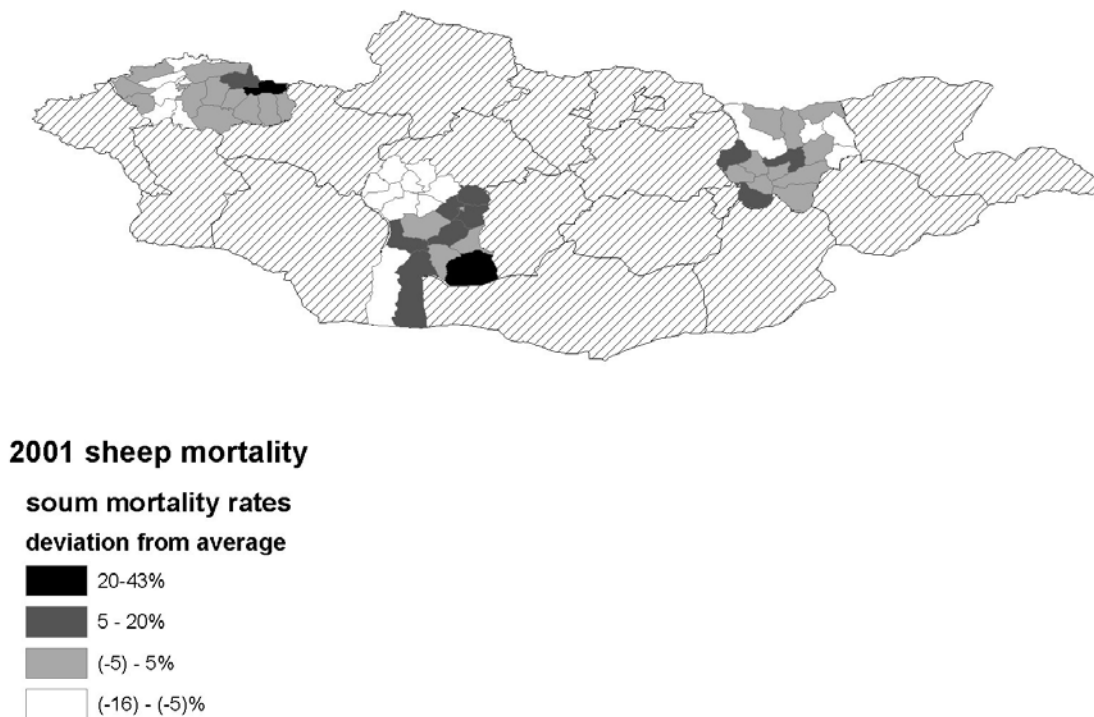
Source: Authors.

6.3.   *Lack of education and knowledge about index insurance among herders*

The pilot program has a strong outreach component to inform herders about the attributes of the index insurance product. Software that gives the historic payouts by species will be used to give the herders a clear indication of how the bad years match their losses. Focus groups with herders have already been conducted in every *soum* in the pilot *aimags*. These types of activities will be repeated to learn of herder concerns and to help shape the educational material used. Radio

campaigns, local presentations, newsletters, press releases and a wide array of other activities are planned.

Beyond the educational efforts, monitoring and evaluation efforts will be conducted throughout the pilot program to learn how well herders understand the products and to learn if informal and formal risk sharing mechanisms are being developed to complement the index insurance. Another critical item to be investigated is the extent to which the index insurance products change the lending behavior of formal and informal lenders in the pilot areas.

6.4.   *Potential for fraud in the countryside*

This pilot project will represent the first effort to organize sales of insurance in some of the pilot area. The potential for fraud or even unintentional mistakes is significant. Every effort has been made to mitigate these problems. Sales agents must undergo training and become certified before being approved to sell BIP. Once certified, agents will be issued a perforating stamp with a unique identification number and a set of numbered sales sheets. For each transaction multiple sales sheets will be perforated with the unique identification stamp. Redundant systems are in place to validate the sales. Herders will also have the opportunity to validate the sales at the local government level in the fall well before any losses occur. All of these systems have been organized to minimize the likelihood that any herder will present a sales sheet at the time of the loss and discover that they are not entered into the record in a proper fashion. Insurance companies have every incentive to maintain the integrity of the system as they will be responsible for any herder losses that occur outside the documented record of sales. Such exposure would also be outside the LIIP and the GoM stop loss system. In addition to the detail for the individual sales, redundant systems will be created in tracking all sales and paying all losses. The LIIP itself assures that herder premiums are completely protected until time of settlement.

7.   **Experience to Date**

The first sales season for the Index-based Livestock Insurance pilot project proceeded better than expected in terms of herder participation. However, as expected, the first sales season of the pilot program revealed some areas where adjustments were needed. In addition, herders and participating insurance companies brought forth concerns and recommendations for the pilot program. The types of issues raised highlight the need for very thorough and clear education of stakeholders. Misunderstandings and confusion about the IBLI program can lead to its demise. Herders must have a clear understanding about the terms of the BIP and DRP contracts and how the insurance works to ensure their trust in the program, insurance companies and confidence in the calculation of indemnities. Transparency of information is an important aspect of this. Likewise, insurance agents and local staff must have a solid understanding of the program to convey the details to the herders and to ensure that the program operates the way it is designed.

Skees and Barnett develop the case for linking index insurance to lending. These arguments were made to lenders in Mongolia. As a result, the three major lenders agreed to lower interest rates for herders purchasing the BIP insurance. In some cases, they are also willing to loan more for herders who have BIP insurance. On average the rates were lowered by 1.2 percentage points annually. Furthermore, herders who have the BIP insurance can obtain these preferential interest rates anytime during the period they are insured by BIP. Herders are now working the math to calculate how much of the BIP premium will be paid by these lower interest rates. Additionally, it is anticipated that access to credit will improve given this form of insurance.

The first sales season took place from April 1 to July 10 of 2006. The insurance protected against losses in the first five months of 2007. Three insurance companies were involved in the sales with 142 certified insurance agents operating in all 56 soums. Sales were greater than expected in

numbers with around 9 percent of herders purchasing the BIP. The total premium exceeded US$78,000. Just over 2,200 herders purchased the BIP and 200 herders enrolled in only the DRP product. Nearly 300,000 animals were insured under the project in the first year. Between 6 and 7 percent of the animals in the pilot region were insured. Given that around 9 percent of the herders purchased insurance, it is clear that on average herders with herd size smaller than average were the primary purchases of the insurance products.

Most herders purchased the lowest level of coverage (30 percent of the value of their animals). In year two, herders can select either a 6 percent or a 10 percent mortality threshold for the BIP. The educational efforts are trying to encourage the herders to consider the 10 percent threshold with a higher value of insurance as a better risk management strategy to protect against the most severe losses.

Participating insurance companies were allowed to charge an operating load beyond the risk-loaded premiums. These loads averaged around 25 percent of the risk-loaded premiums. Insurance companies indicated that these loads may be raised in the second year.

An extensive educational and promotion effort was undertaken in the first year of the project. Face-to-face education took place with 95 percent of the herders (over 27,000 herders). Although the face-to-face education made a significant contribution to the herders understanding of the IBLI product, some confusion on the understanding of the 'losses' to be covered under the IBLI scheme remained. As part of the monitoring and evaluation of the project, some 670 people were interviewed in focus group discussions. Over 85 percent of the herders indicated that they had received IBLI information. Of the herders interviewed, about 15 percent had purchased the BIP. Over half of these herders like the idea that they would be paid during the difficult *dzud* event even without proving they had any losses.

Despite the significant educational efforts which included some strong information about the careful considerations to assure payments, a number of herders continued to be influenced by the past negative experience where livestock insurance did not pay for losses during the most difficult times. These views appear to have influenced the purchase decision. It is likely that these views would change if there are some losses paid during the pilot project.

8.   Conclusion

The Government of Mongolia requested specific assistance from the World Bank in coping with extreme livestock losses. This paper gives the background and details for a pilot program that will test index-based livestock insurance. A World Bank loan of US$9.44 million was approved in May 2005. This loan includes both technical assistance to run a three year pilot program in three *aimags* in Mongolia and a US$5 million contingent debt facility to serve as a mechanism for protecting the GoM against extreme losses during the pilot. The proposed pilot involves three distinct layers of risk: self retention by the herders for low mortality rates; commercial base insurance product for intermediate mortality rates; and safety-net disaster response product for high mortality rates, i.e., beyond the layer covered by the BIP.

An index-based insurance program was recommended because of significant concerns about moral hazard, adverse selection, and extreme monitoring costs associated with any individual livestock insurance program in the vast open spaces of Mongolia. While it is believed that the index-insurance product can be effectively underwritten, significant financial exposure for a nascent insurance market that has extremely limited access to global risk shifting markets remains among the largest challenges. Given concerns about financing extreme losses, the pilot design involves a syndicate pooling arrangement for insurance companies. This pool ring fences this

line of business and thus protects the domestic insurance market against any financial contagion caused by extreme livestock losses. In the short term, the Government of Mongolia will offer an unlimited stop loss on the pooled risk of the insurance companies.

In the syndicated pooling arrangement, participants share underwriting gains and losses based upon the share of herder premium they bring into the pool. Each insurer also pays reinsurance costs that are consistent with the book of business they bring into the pool. This gives the reinsurance pool the benefits of the pooling arrangement and provides the opportunity to build reserves for the overall activity. The reinsurance pool pays for the first layer of losses beyond the stop loss. Once the reinsurance pool is exhausted, the Government of Mongolia can call upon the World Bank contingent debt to pay for any remaining losses.

A major advantage of having a prepaid indemnity pool is that all other lines of insurance business are protected from the extreme losses that can occur from writing an agricultural risk that is highly correlated. In addition, the pooling mechanism allows participating companies to spread their risk among all insurers involved in the sale of the BIP product. Given that BIP is a standard product that involves the same premium rates from all companies, the issue of trust and due diligence of the underwriting skills of participating insurers is greatly reduced. This is important as typical pooling arrangements among insurance companies are generally very difficult to organize given the high transaction costs needed to perform due-diligence on underwriting skills of the participating insurers. The longer term vision is that the pooling mechanism created in the pilot can be well positioned to find risk-sharing partners in the global community quickly as the pooling arrangement is both risky and profitable. Reinsurers might be willing to provide capital and enter quota-share arrangements on that risk. To the extent that the risks within the pool are standardized, using the same measures and procedures, one can also envision this mechanism serving as a means to securitize the risk. Finally, the design also offers the opportunity to transition the system to the market once it is learned whether herders find the BIP an acceptable product and demonstrate a willingness to pay.

This lending operation, which offers the World Bank for the first time ever the opportunity to design and implement a country-wide agriculture insurance program, paves the way to the development of financially sustainable agriculture insurance programs offering affordable and effective insurance coverage while limiting the fiscal exposure of the government.

As of May 2006, the pilot program is moving forward with three insurance companies approved for sales. The sales season started late April and will end early July. The design of the program is being effectively implemented. Companies were required to submit a strategic plan using specially developed portfolio software. This allowed the companies to evaluate the tradeoffs between their administrative cost and the cost of reinsurance. Administrative cost increase as companies attempt to expand their reach into the entire market. Reinsurance cost decline as companies spread their risk over the market. Companies made rational choices. In the initial plans some 90 percent of the market is covered. A few soums were excluded from company plans. In particular, some large soums with low number of animals were excluded. A challenge from the government steering committee was that there should be universal coverage of the product. Here again, the presence of two products, the market-based BIP product and the social-based DRP product, provided some counterbalance to the argument that companies should be selling index-based livestock insurance everywhere. An extensive promotion and public awareness campaign is being planned. At this stage, it is uncertain how herders will respond to these new insurance products. Two banks are offering lower interest rates and/or longer loan terms for herders purchasing the BIP product.

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Annex 1.   Risk profile of the three pilot aimags

Bayankhongor

	CATTLE	SHEEP	GOAT	HORSE	**TOTAL**
Total no. of animals	95,791	425,299	607,366	70,268	1,198,724
Total value of animals	$8,621,190	$10,845,125	$8,199,441	$5,797,110	$33,462,866
Average AL	$494,434	$626,667	$425,628	$326,101	$1,872,829
Standard Dev. AL	$1,072,979	$854,178	$710,870	$1,126,159	$2,387,391
Average AL (%)	5.7	5.8	5.2	5.6	5.6

Khentii

	CATTLE	SHEEP	GOAT	HORSE	**TOTAL**
Total no. of animals	147,046	646,048	396,054	172,161	1,361,309
Total value of animals	$22,056,900	$16,151,200	$6,336,864	$10,760,063	$55,305,027
Average AL	$1,341,429	$903,933	$359,319	$569,370	$3,174,051
Standard Dev. AL	$1,185,466	$706,834	$305,498	$507,722	$1,818,618
Average AL (%)	6.1	5.6	5.7	5.3	5.7

Uvs

	CATTLE	SHEEP	GOAT	HORSE	**TOTAL**
Total no. of animals	86,796	792,870	563,828	63,743	1,507,237
Total value of animals	$9,547,560	$19,028,880	$7,893,592	$7,330,445	$43,800,477
Average AL	$529,740	$775,002	$345,186	$404,539	$2,054,467
Standard Dev. AL	$686,184.08	$1,094,947	$415,744	$513,609	$1,464,185
Average AL (%)	5.5	4.1	4.4	5.5	4.7

AL: annual loss

Annex 2. Livestock risk exposure of the insurance industry

Insurance penetration (assumption)

	Uvs	Bayankhongor	Khentii
Company A	4%	0%	0%
Company B	0%	4%	0%
Company C	0%	0%	4%
Company D	6%	6%	6%
Total	10%	10%	10%

Livestock Insurance Indemnity Pool

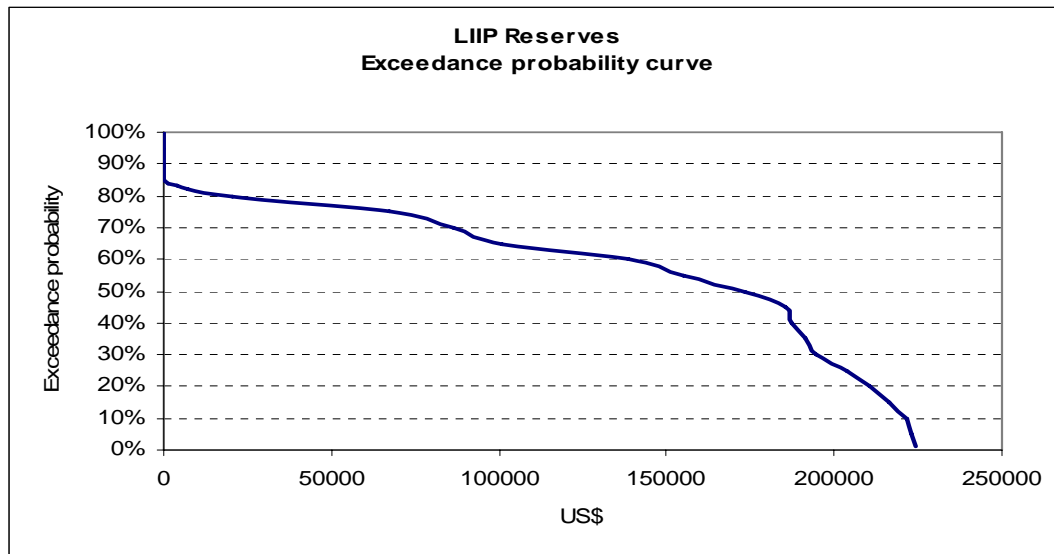| Premium volume	US$215,000
Reserves	US$276,000
Reinsurance cost	US$50,000

Estimates.

LIIP Reserve (excluding financial gains from interest earnings)

Average	US$133,000
Coefficient of variation	64%
Prob[LIIP fully depleted]	15%

Estimates.

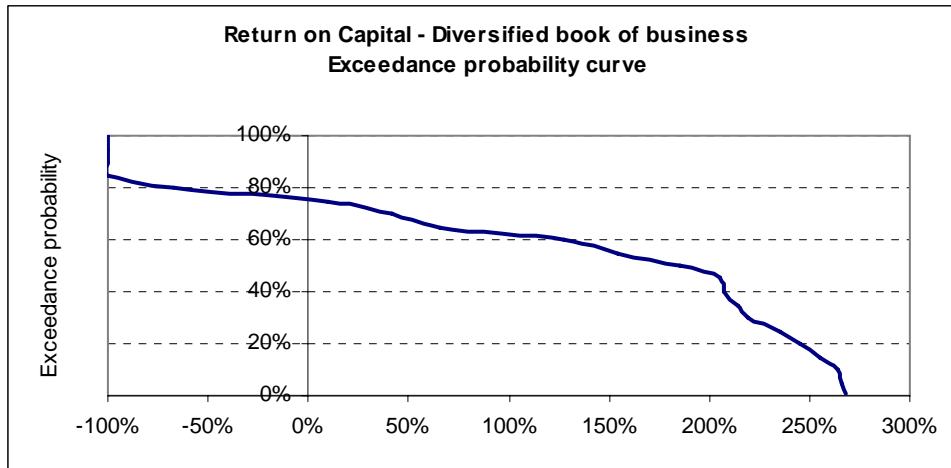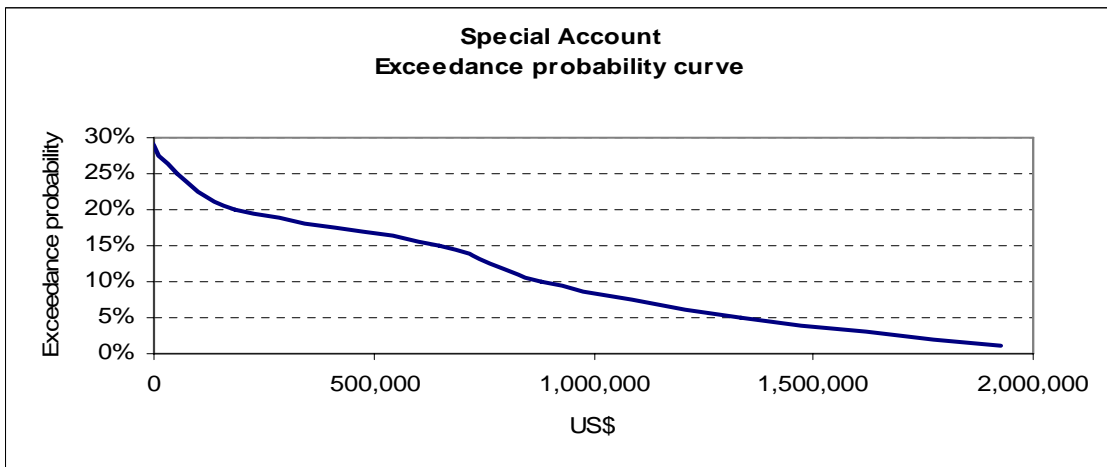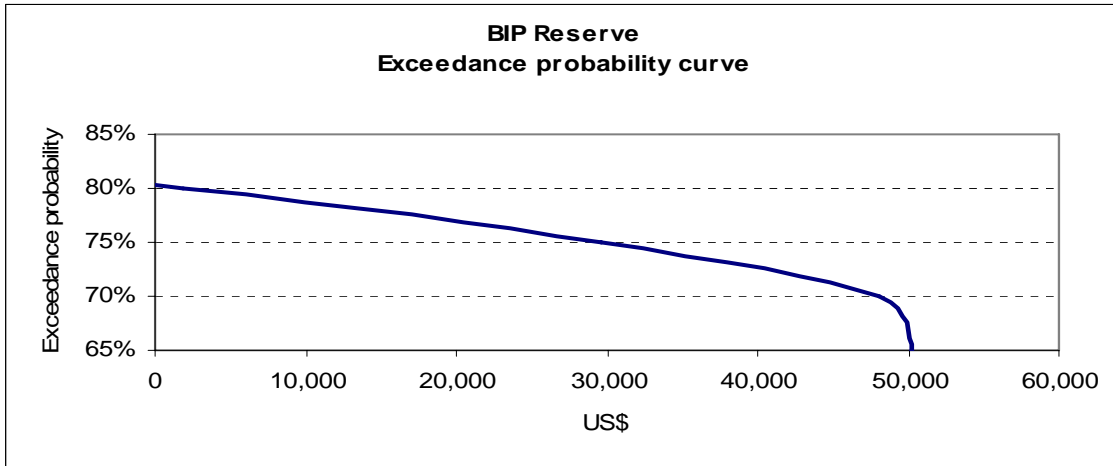LIIP Reserves
Exceedance probability curve

Return on capital (ROC) of the participating insurance companies (including interest earnings @13%)

	Company A	Company B	Company C	Company D
Average	72%	72%	73%	119%
Standard deviation	91%	91%	91%	116%
median	113%	113%	113%	170%
Prob(ROC<0%)	24%	24%	24%	24%
Prob(ROC>100%)	58%	58%	58%	62%

Return on Capital - Diversified book of business
Exceedance probability curve

Annex 3. Livestock risk exposure of the Government

**BIP Reserve
Exceedance probability curve**

**Special Account
Exceedance probability curve**

Participation: BIP 10%, DRP 30%.
Reinsurance premiums: $ 69,000

Government position

	Loss
Average AL	$96,000
Coefficient of Variation	433%0
Prob[loss>0]	20%
Estimates.	

Government total payments
(simulations based on historical livestock losses**)**