Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED)

The Feasibility of Index-Based Livestock Insurance (IBLI) in the West African Sahel

Framing the issue

(Livestock around a pastoral borehole in northern Senegal during the dry season, 2002)

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1. CONTEXT OF THIS DOCUMENT

This document is part of the implementation of the project Building Household Economic Resilience through livestock productivity in the south and east of Mauritania (*Projet de Renforcement de la Résilience de l'Économie Familiale grâce à la productivité de l'élevage dans le sud et l'est de la Mauritanie* - PRREF-Mauritania), financed by the European Union. In the wider context – and through a co-financing mechanism – the PRREF-Mauritania project is aligned with the DFID (UK Aid) BRACED program, under implementation by AFL since January 2015, which also covers Mali, Niger, Burkina Faso and Senegal.

As part of the interventions in Mauritania, "an exploratory study of microinsurance issues linked to livestock in the context of trans-border mobility" was planned as a key element of the BRACED Program. Given the complexity of the subject, it was agreed during the BRACED inception workshop in Sikasso-Mali (January 2015), as priority, to map the main issues in order to better grasp the next steps of the process. Conducted in February-March 2015, the study draws on a review of the literature related to microinsurance in general, and agricultural insurance in particular. Given the growing popularity of index-based insurance systems, this review focused, in particular, on livestock insurance in Mongolia and in northern Kenya.

In addition, taking advantage of a workshop organized by BRACED in Dakar in February 2015, meetings were held with private and public stakeholders in Senegal, where index-based insurance is currently being launched along with more traditional insurance products.

2. MICROSINSURANCE AND INDEX-BASED INSURANCE

2.1 MICROINSURANCE: A NECESSARY RESPONSE TO A GROWING DEMAND

The most recent studies on microinsurance confirm that, worldwide, the majority of producers bear by themselves the burden of managing risks and dealing with impacts. Rural areas in particular account for 80% of the population facing a large variety of risks, among which drought is the most commonly cited. These studies also show that, in poor countries, without insurance to guard against risk, households generally take decisions aimed primarily at preserving the integrity of their lifestyle and, when a shock occurs, attempt to recover from it as best as possible by tapping into their social networks.[1] However, when these networks reach their limits, the inability to transfer risk elsewhere also constitutes an additional factor of vulnerability to crises.

Microinsurance thus appears to constitute a necessary response to a virtual absence of social protection systems in many countries. Broadly speaking, microinsurance can thus be defined as a protection mechanism for individuals with low incomes against risk (accident, sickness, death in the family, natural disaster) in exchange for the payment of insurance premiums adapted to their need and the level of risk. It is mainly targeted at low-income producers in developing countries, particularly those engaged in productive activities in rural areas or in the informal sector and who are often underserved by commercial insurers and social insurance systems.[2]

In Africa, microinsurance is available through different channels: cooperatives, mutual health insurance and other community programs, non-governmental organizations (NGOs),

[1] **Awel Y., and Azomahou T**., 2014, Productivity and welfare effects of weather index insurance : Quasi-experimental evidence, Maastricht University and United Nations University, Paper presented at the International Microinsurance Conference 2014, Mexico City

[2] **Phily C**., 2009, Micro Insurance Innovation Facility, FANAF General Assembly, February 2009, Yamoussoukrou, Côte d'Ivoire.

microfinance institutions (MFIs), regulated commercial insurers and informal mechanisms such as tontines, burial societies and other support groups. However, the level of penetration of microinsurance remains weak on the African continent. In 2008, there were about 14.7 million people covered by insurance, or 2.6% of the target population. Southern and Eastern Africa dominate the microinsurance landscape with, respectively, 8.8 million and 4 million people covered. This leaves only 1.9 million people covered in Central, North and West Africa. In French-speaking countries, the widest range of products and the largest number of beneficiaries can be found in Senegal, Benin, Burkina Faso and Cameroon. The market is dominated by life insurance products. An analysis by product shows that accidental death insurance accounts for around 9.5% of their potential market, with other life insurance products accounting for approximately 3.2%. Health products, which are often cited as being the most sought after, cover only 0.3% of the low-income population. Property insurance and agricultural insurance cover even less people, representing 0.2% and 0.1%, respectively, of their potential markets.[3]

In the last 15 years, however, agricultural microinsurance has taken center stage. This trend has been reinforced during the last 10 years through growing investment by Governments and their development partners in adapting to climate change and in the development of safety nets. In the West African context, the recent or imminent adoption of agro-sylvo-pastoral legislations by several countries (Mali, Senegal, Burkina Faso, Niger) has greatly contributed to this growth. Indeed, by strengthening the status of rural producers, these laws have spurred the implementation of social security and insurance systems to combat the risks associated with rural production.

2.2 Conventional microinsurance products and index-based agricultural microinsurance

As a general rule, private insurers prefer to sell microinsurance products to individuals, covering specific and independent risks, such as health insurance, life insurance, fire insurance and accident insurance. Products specifically designed for agricultural production are rare. They often contain many exclusions (insurance restricted to frost or hail, etc.) and are mainly targeted at commercial farms dedicated to production of high value crops (such as, for example, vegetable producers in Mexico who export their products to the United States).

However, adapting conventional microinsurance products to livestock or agricultural production has been facing several limiting factors. Conventional insurance carries with it a high "moral hazard": a farmer whose indemnity is based on crop loss may be incentivized to stop investing in his production systems. Equally problematic, producers who consider themselves highly risk prone will ask for higher levels of protection, leading to a general increase in insurance premiums. The high cost of insurance also comes from the need for insurance companies to assess, for each producer, the damage incurred and to quantify the economic losses. This is possible in the case of large agricultural operations, but unmanageable in countries where family farms are small, widely dispersed and often difficult to access. This results in very high "transaction costs" which affect the annual level of premiums to be paid by producers.

[3] **Desjardins International Development**, 2011, Study on microinsurance in the CIMA zone: status and recommendations. This is a study on microinsurance conducted on behalf of the African Federation of Insurance Companies for African National Law (FANAF) and the Inter-African Conference of Insurance Markets (CIMA) with the financial support of the World Bank. CIMA is the integrated body of the insurance industry from the 14 countries of Francophone Africa.

In low income countries, traditional agricultural insurance would thus seem to be too costly (both for producers and insurance companies) and is certainly unworkable in practice. In fact, it is relatively rare. Even in the USA, Europe or Australia, multi-risk agricultural insurance was only achieved through state subsidies.[4]

Several contextual elements also called for the exploration of other solutions: adaptation to climate change, long-term disaster relief management, strengthening of the resilience of poor and vulnerable populations. It was therefore foreseeable that, sooner or later, public and private operators would turn to what is termed "climate index-based insurance", more commonly called "index-based insurance".

Considered both as a support tool in cases of disaster and as a vector for development, index-based insurance has several special features.[5] It is a product linked to an index showing a strong correlation with the level of production. The insurance contract generally guarantees against specific risks or events (e.g. a hurricane, a drought, a flood). These risks are often defined at a regional level and the payment of compensation payouts to policy-holders is triggered when the index reaches a critical threshold.

Index-based insurance differs from conventional insurance products, for which compensation is based on an assessment of losses at the level of individual customers. For index-based insurance, it tends to be based on the monitoring and measurement of a particular index which may be linked, for example, to climate (such as: the amount of rain which fell during a period considered decisive for production) or to an estimate of production losses for a particular region. The compensation process is thus triggered when this index reaches a predetermined threshold.

Index-based insurance does not cover all risks that producers may incur. However, by focusing on one specific risk, judged the most important (for example, drought), insurance companies are able to reduce the level of premiums to be paid by producers, as they not only focus on a single risk, but can also more easily quantify the probability of having to pay compensation payouts.

An important principle is that all buyers pay the same premium and, in case of disaster, all receive the same compensation. Since compensation is linked to a specific index, such as rainfall or satellite measurements of vegetation, there is no need to individually visit producers to confirm their losses (crops, livestock), which also reduces the management costs of insurance companies and, as such, the level of premiums that producers must pay. Moral hazard is also virtually eliminated, since compensation no longer depends on the performance of the producer. As such, in bad years, producers have a vested interest in trying to protect their crops, since they will benefit from compensation anyway, and will be winners twice over. This results in a considerable lowering of transaction costs, all while giving insurance companies the ability to reach a large number of producers spread over a wide geographical area.

Index-based insurance thus takes over traditional risk management methods by populations when it comes to infrequent risks which simultaneously affect a large number of people, and thus go beyond the usual capabilities of individual producers and their social networks.

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[4] **Greatrex H, Hansen JW, Garvin S, Diro R, Blakeley S, Le Guen M, Rao KN, Osgood, DE**. 2015. *Scaling up index insurance for smallholder farmers: Recent evidence and insights*. CCAFS Report No. 14 Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at: www.ccafs.cgiar.org

[5] **FIDA**, 2010, *L'assurance basée sur un indice climatique: potentiel d'expansion et de durabilité pour l'agriculture et les moyens de subsistance en milieu rural*, par P. Hazell, J. Anderson, N. Balzer, A. Hastrup Clemmensen, U. Hess et F. Rispoli. Rome.

Index-based insurance has two potential benefits. On the one hand, it helps strengthen the resilience of small producers by compensating them in bad years, thus allowing them to survive a crisis and protect their assets. On the other hand, it allows them to access other opportunities in better years, for example, by giving them easier access to credit and, consequently, the ability to invest in newer and better paying technologies. In different parts of the world (especially Ethiopia and India), several studies have shown that taking out an insurance policy against climate risks allows producers to transfer a part of their risk to other economic actors (external insurance agents), explore new production techniques (use of fertilizers, for example), provide better guarantees to obtain credit and, ultimately, to increase their productivity.

2.3 THE BASIS RISK: AN INHERENT WEAKNESS IN INDEX-BASED MICROINSURANCE

Index-based insurance nonetheless has a decisive structural weakness, which is called "basis risk" and which is directly related to the nature and reliability of the index used.

Ideally, the index used must correspond to a high impact weather event which has a widespread and similar effect on all producers. The correlation between the evolution of the index chosen and its effects on production levels must thus be closely established, which is called covariance. If the behavior of two variables are observed (for example, the link between the level of rainfall and harvests), the degree of covariance indicates the extent to which these two variables change simultaneously, or not. The stronger the covariance, the narrower the correlation. For example, if the index indicates a relationship between the level of rainfall and crop yields, a strong covariance means that the less rainfall there is, the lower the harvest will be, through a simultaneous movement over the entirety of the observed zone. As a result, the insured risk must also be covariant, that is to say that it must touch everyone at the same time and in the same way, for example, a drought or a flood.[6] Conversely, a low covariance means that a decrease in rainfall has only a limited and highly differentiated impact on crops, depending on the individual producers.

Index-based insurance must thus be based on an index guaranteeing a high correlation between the weather event and its impact on producers. This is the only way to avoid a basis risk, namely the potential asymmetry between payouts triggered by the index and the actual losses suffered by the insurance policy holder. With this type of insurance, the compensation is the same for all producers insured in the region. As such, it is possible that, in some years, some producers receive a compensation without having incurred any losses and, other years, incur losses without receiving any compensation. Indeed, it is possible for an individual farmer to lose his crop following a drought, but not receive any compensation because the drought was not picked up by the meteorological station used as point of reference. Finally, the variety of microclimates, the heterogeneity of the physical environment (e.g. the topography) and the diverse types of household production systems within the same geographical unit will increase the "basis risk" that is inherent in index-based insurance.

2.4 THE DIVERSITY AMONG INDEX-BASED INSURANCE PROVIDERS: THE MAIN PLAYERS

Various index-based insurance systems have been developed in the United States, in Canada, in India and in Sweden since the 1980s. These insurance products are however more recent in the African context. The world of index-based insurance is diverse. Products include both non-subsidized schemes offered by private companies (associated with full benefit packages, including information for agricultural development and ancillary services for farmers) and highly subsidized schemes offered by public agencies. In India, the PepsiCo program, aimed at small potato farmers, illustrates this first variant, while the AIC (Agriculture Insurance

[6] Source: Sara Teillard-Acting for Life.

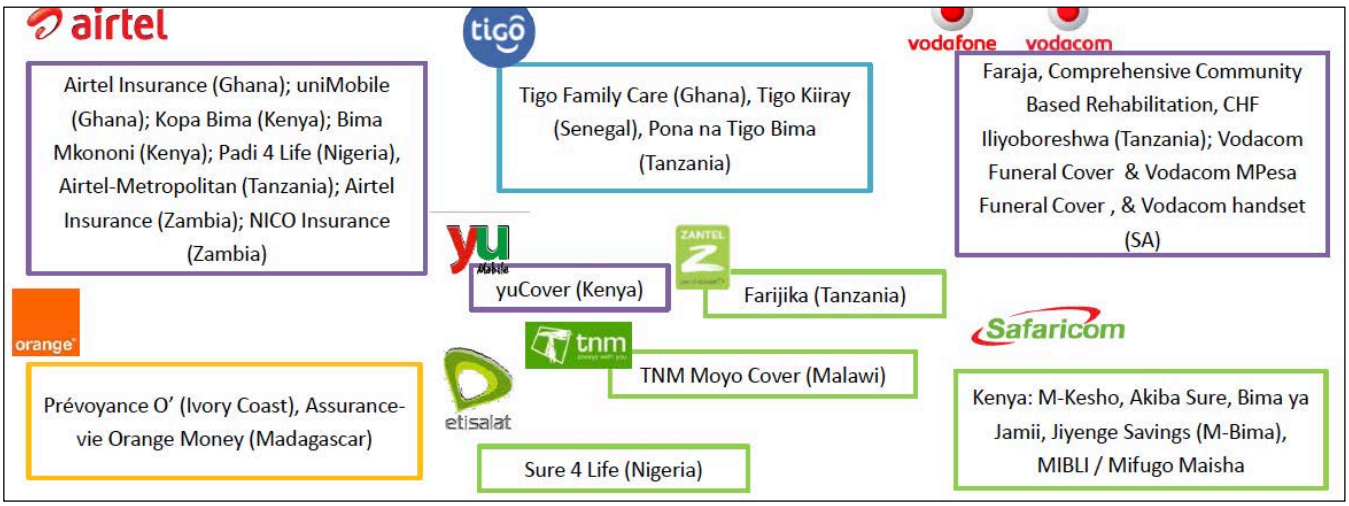
Company of India) program, very heavily subsidized, offers all interested farmers insurance based on an index of local yields combined with drought insurance. More generally, in the event of a major disaster, there are many relief programs which can take the form of international insurance schemes that directly guarantee the costs of emergency government measures or of programs run by NGOs that provide emergency disaster insurance directly to communities or farmers.[7]

Index-based insurance thus implies the development of public-private partnerships, often based on the need for joint investment. For example, by improving financial services in rural areas and climate information systems, the government gives private insurers access to potential clients and facilitates the development of index-based insurance.

In addition to the government and the private insurance companies, reinsurers are another very important actor. By definition, basis risk is reduced when it comes to insuring a high covariance event. However, this implies that when such an event occurs, the insurer must have the means to compensate, at the same time, a large number of producers located over a vast area. In such situations, the insurer has no choice but to sell part of the risk on the international market. The simplest form of reinsurance is a contract under which the insurer benefits from protection if its losses exceed a certain level. It may also be a quota-share reinsurance agreement, based on sharing both premiums and compensations.

Reinsurance can, in itself, also be a driver of economic activity, because reinsurers are willing to assume a significant share of the risk. This allows conventional insurance, for which reinsurers require retention levels amounting to at least 15% of the risk, to exclude moral hazard. By bringing in a third and objective party, insurance based on climate indices thus makes possible, in theory, very high levels of reinsurance.

In some countries, particularly in Eastern and Southern Africa (and in Ghana, Ivory Coast and Senegal for Western Africa), a growing involvement of Mobile Telecommunications Operators (MTO) for the promotion of products, the payment of premiums, and the payment of compensation may be noted:



Source: **Leach J.**, 2014, From Freemium to Premium: mobile distribution, Bankable Frontier Associates, Paper presented at the International Microinsurance Conference 2014, Mexico City

[7] **FIDA**, 2010, *L'assurance basée sur un indice climatique: potentiel d'expansion et de durabilité pour l'agriculture et les moyens de subsistance en milieu rural*, by P. Hazell, J. Anderson, N. Balzer, A. Hastrup Clemmensen, U. Hess and F. Rispoli. Rome.

For now, these operators are mostly involved in conventional microinsurance (health or accident insurance, for example) but their role may also expand into index-based insurance and safety nets, especially for money transfers.

2.5 Constructing a climate index: a complex and demanding work

Indices linked to climate may take on a variety of forms. For example, in the province of Tigray in Ethiopia, the index-based insurance system implemented by OXFAM America is based on two annual indices: a delay in the start of the rainy season and a rainfall deficit, on the one hand, and an early end of the rainy season, on the other hand. Insurance can be bought by producers through either cash or labor (insurance for work). The index can be linked to various references: deficits or, conversely, excesses in rainfall, evapotranspiration, humidity in the soil, temperature rise, or wind speed.

There are various observation/measuring tools, according to the index chosen:

- Normalized difference vegetation index: VITO, ITC (SPOT-VGT NDVI/fAPAR data over 1*1km; TAMSAT rainfall estimates over 8*8 km),
- Actual evapotranspiration: FewsNet (USGS); MODIS data over 1*1 km)
- Relative evapotranspiration: EARS (MSG data over 3*3 km),
- Radar estimation of soil moisture content: GEOVILLE (ERS data over 50*50 km; METOP ASCAT over 50*50 and 25*25 km),
- Radar crop estimate: SARPMPA (Synthetic Aperture Radar), CosmoSkyMed data over 3*3 km.

The implementation of an index requires significant preparation work (calculation of historical climate data and agricultural yields, or agricultural performance), as well as adequate infrastructure. For example, if the index used is the level of rainfall, it is imperative for an insurer to have a precise historical database to evaluate the impact of a millimeter of rain on agricultural yields. It is then necessary for the insurer to determine the base rainfall in order to select the trigger levels for compensation, as well as the maximum threshold for payment. In an insurance system for agriculture, the premium level will then be based on the cost of production for a given crop type (maize or groundnuts, for example), with compensation based on the rainfall gap (between the level recorded through the dataset and the reference level set at the time of subscription), valued according to the cost of production (insured sum).[8]

3. INDEX-BASED INSURANCE AS APPLIED TO LIVESTOCK

3.1 Livestock insurance: some benchmarks

The first livestock insurance products are to be found in Japan, which introduced livestock insurance (covering in particular milk-producing animals) beginning in 1929, ten years before introducing agricultural harvest insurance. This livestock insurance provided insurance on the lives of the animals (excluding slaughter), and to which small producers could subscribe. If a producer subscribed to the insurance, he was also required to insure all of his horses and other cattle, while the nearest cooperative, on which the producer depended, reinsured half to the government.[9]

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[8] **Ndiaye A**., 2012, *L'assurance agricole au Sénégal, un système en construction*, presentation made during the FARM-Pluriagri Seminar: *assurer la production agricole, comment faire des systèmes assurantiels des outils de développement ?*, Paris, December 18th, 2012.

[9] **Food and Agriculture Organisation of the United Nations**, 1966, *Le développement de l'agriculture au Japon moderne : portée de l'expérience japonaise*, Study on Agricultural Planning #6.

Traditional insurance products covering livestock are common, particularly for high-value animals (race horses and breeding cattle, for example). An animal is insured for a series of risks, of which the most common are accidental injuries or fatalities. Like any conventional insurance, establishing a baseline is compulsory: the health status of the animal (veterinary control) and its commercial value, among others. In general, guarantees are required, particularly in terms of health monitoring and ear-tag identification of the animal. In case of disaster, the independent verification and evaluation of damages are also part of the contract. This type of insurance is currently available in Senegal, through the CNAAS.

However, in the case of extensive livestock systems deployed across large areas and subject to climate risks, conventional insurance has proven itself to be inadequate: high transaction costs, difficulties in reaching vast areas and in offering a mass insurance product. For all of these reasons, index-based insurance has rapidly emerged as an alternative. Since the 1980s, countries such as the United States and Canada have embarked on index-based insurance. In Ontario, for example, livestock drought insurance was developed based on the principle that the productivity of forage crops remains closely linked to rainfall and that, in case of rainfall deficits, yield declines of between 20 to 40% were common, with no possibility to secure two hay cuts during the same season. Following a severe drought in the late 1990s, an experimental index insurance plan was implemented (the "Forage Rainfall Plan"), which is now an integral part of the Provincial Government's Production Insurance. The insurable crop consists of forage, grasses and legumes, as well as hay fields and improved rangelands. A network of 350 rainfall data collection stations distributed across the province at 15km intervals generates precipitation indices. Current and historical climate data allows insurers to determine the differences between the climatic conditions of any given season and historical averages.[10]

Outside of these countries, index-based livestock insurance remains a new and experimental field. Insurance products found in India remain strongly influenced by traditional insurance, combined with the introduction of new technologies for the remote monitoring of animals, such as inserting electronic identification chips. In Uruguay, an index-based insurance for small farmers is currently being implemented. However, the first tests are only planned to take place in 2015.[11]

In the final analysis, there are only a limited number of existing programs in a context that directly compares with the experience of pastoralists and agropastoralists in the Sahel. Two main experiences should be seen as most relevant: Mongolia and northern Kenya. They provide sufficient perspective to have a clear vision of the challenges posed by index-based insurance in extensive livestock systems strongly influenced by climatic variations. Studies conducted in southern Ethiopia are still recent (the first products were only marketed in 2014) and remain strongly modelled on the Kenyan experience. In addition, the livestock insurance products currently in place in Senegal through a close partnership between private operators (Planet Guarantee acting as broker) and the state, with the *Compagnie Nationale d'Assurance Agricole du Sénégal* (CNAAS) are worth studying.

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[10] Compensation thresholds trigger depending on deficits. The benefits are paid if rainfall systematically corresponds to less than 80% of the long-term average of the area. (**IFAD/FIDA**, 2010, Forage Rainfall Plan in Ontario, Canada, 2014, Case Study in Insurance Based on a Climate Index: potential for expansion and sustainability for rural areas).

[11] The Uruguayan project primarily aims to control risk associated with excess rainfall for horticultural crops on the one hand, and the management of livestock grazing routes on the other. Currently in the development stage (pilot experience planned for 2015 as part of the IFAD project), index-based insurance for livestock grazing land has been designed with help from the World Bank and aims to compensate small herders in case of extreme drought. Insurance is purchased by the State. (**Quintans D., and al.,** 2014, Lessons learned form index insurance in Uruguay, Paper presented at the International Microinsurance Conference 2014, Mexico City.

3.2 MONGOLIA'S PIONEERING EXPERIENCE

The semi-nomadic and nomadic herders of Mongolia represent about 30% of the population of the country, with a herd estimated in 2011 at 36 million heads (of all species) and whose subsistence relies mostly on communal rangelands. The country's livestock systems are unique in that they usually include all types of ruminants (camels, goats, sheep, cattle) as well as horses, whose milk is also consumed. The size of a family herd is generally large (several hundred animals).

Being a semi-arid steppe landscape, the natural environment is subjected to brutal seasonal variations, from rigorous and freezing winters to extremely dry summers. Particularly harsh winters are referred to as "*dzud*s". In early December, freezing temperatures can drop to below -25°C and are accompanied by heavy snowfall. In January and February, cold fronts from Siberia bring heavy snowstorms with temperatures down to -50°C.

Unlike a drought in the Sahel, during which farmers tend to migrate south, there is no possibility in Mongolia to escape a *dzud*. Everyone is affected. *Dzuds* cause very high mortality among herds, involving significant economic losses for farmers and for the national economy. In the early 2000s, a series of *dzuds* caused the death of 11 million animals. It was at this time that the Government of Mongolia and the World Bank set up an index-based livestock insurance. Since then, other *dzuds* have occurred, notably in 2008 and 2011.[12]

The implementation of an index-based insurance for livestock was based on an index of mortality rates, for which Mongolia had long and uninterrupted historical data, beginning in 1920. Such an index was thus more relevant than an index based on the climate itself. Its practicality was also evident, since the statistical data regularly provided by the government allowed for the preparation of aggregate mortality rates at the district level. At the start of the program, the data was compiled and analysed in order to establish, for actuarial purposes, complete series for the predicted mortality of cattle, horses, camels, sheep and goats, for each district of the country.

In 2004, the Government adopted a law authorizing index-based livestock insurance in the country and signed, the following year, a credit agreement with the World Bank to begin the Index-Based Livestock Insurance Project (IBLI). The project was later co-financed by Japan, Switzerland and Korea.

The system works according to three layers of risk:[13]

a. Weak risk: frequent climatic events which have little impact. The losses incurred can be borne by the herders themselves through their own coping strategies.
b. Medium risk: less frequent climatic events with more impact. These events can potentially be insured and the risk transferred to private insurers.
c. High risk: infrequent, with high impact. These events only occur every 30 years or so. Their effects can be devastating and their magnitude requires state intervention to cover risk and manage disasters.

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[12] There were losses of 1 million animals for the single month of January 2011. The SREX (Special Report on Managing the Risks of Extreme Events and Disasters) ordered by the IPCC (Intergovernmental Panel on Climate Change) noted worrying trends for the future: more frequent droughts during the summer, more frequent extreme events (excessive rainfall causing flooding), more severe winters (**DeAngelis K., World Resources Institute**, 2013, Index-based Livestock Insurance : the case of Mongolia, in Inside Stories on Climate Compatible Development, Climate and Development Knowledge Network).

[13] **Luxbacher, Kirsten and Andrew Goodland**, 2011 World Resources Report Case Study. Building Resilience to Extreme Weather: Index-Based Livestock Insurance in Mongolia. World Resources Report, Washington DC.

Given these risks, IBLI-Mongolia offers two overall insurance products:

- Livestock Risk Insurance (LRI, called Base Insurance Product during the pilot phase): a commercial product sold by private insurers at the district level. The payment of compensation is triggered when the livestock mortality rate is between 6 and 30%.
- Disaster Response Product (DRP): a safety net offered by the Government when the mortality rate exceeds 30%. It has since been replaced by the Government Catastrophic Coverage. This product is only available if the herder has subscribed to the basic insurance (LRI).

At the same time, the program proceeded to implement a Livestock Insurance Indemnity Pool. This common fund aims to mitigate relatively high risks borne by private insurers, who can pool all of the fees paid by herders until the compensation process is triggered. At that time, the pool releases the funds to each insurer in proportion to their contribution to the pool, which helps avoid default in case of problems (e.g. the bankruptcy of a private insurer). If the compensation to be paid exceeds the reserves of the pool, the government plays the role of a reinsurer, linked to a contingency mechanism (Contingency Debt Facility) funded by the World Bank.

In practice, the system works as follows: a herder pays a premium based on the declared value of his animals and on the level of estimated risk for the district in which he lives. The herder may choose to insure between 25 to 100% of the value of his animals, which naturally affects the level of the premium. The payment of compensation is triggered when the mortality threshold (the trigger) is reached in the district and for the insured animal species. According to the three risk levels identified above, weak risk corresponds to 6-7% projected mortality. This is the level of risk which the herders must assume themselves. Average risk corresponds to a mortality rate between 7-30%. For the high risk (disaster level), the mortality rate exceeds 30%, which is then considered to be the "exhaustion point."

For example:

> A herder has 36 sheep; whose unit value is 28,320 Tugrik (the local currency). The herder decides to insure all of his sheep for 100% of their value, or 28,320 T. x 36, equivalent to approximately 1,000,000 T. The premium that the herder has to pay (for a basic insurance trigger threshold at 7% and a 30% exhaustion point) is 1.4% of the declared value, or 14,000 T. (equivalent to approximately 3 goats).
>
> Let us suppose that, in a bad year, the mortality rate for sheep in the herder's district is 35%. The payment made through the basic insurance will be 30%-7% = 23% of 1,000,000 T., or 230,000 T. Since the death rate exceeds 30%, the Disaster Fund (DRP) will cover the additional 5%, for a payment of 50,000 T., for a grand total of 280,000 T.

The following figures are instructive:

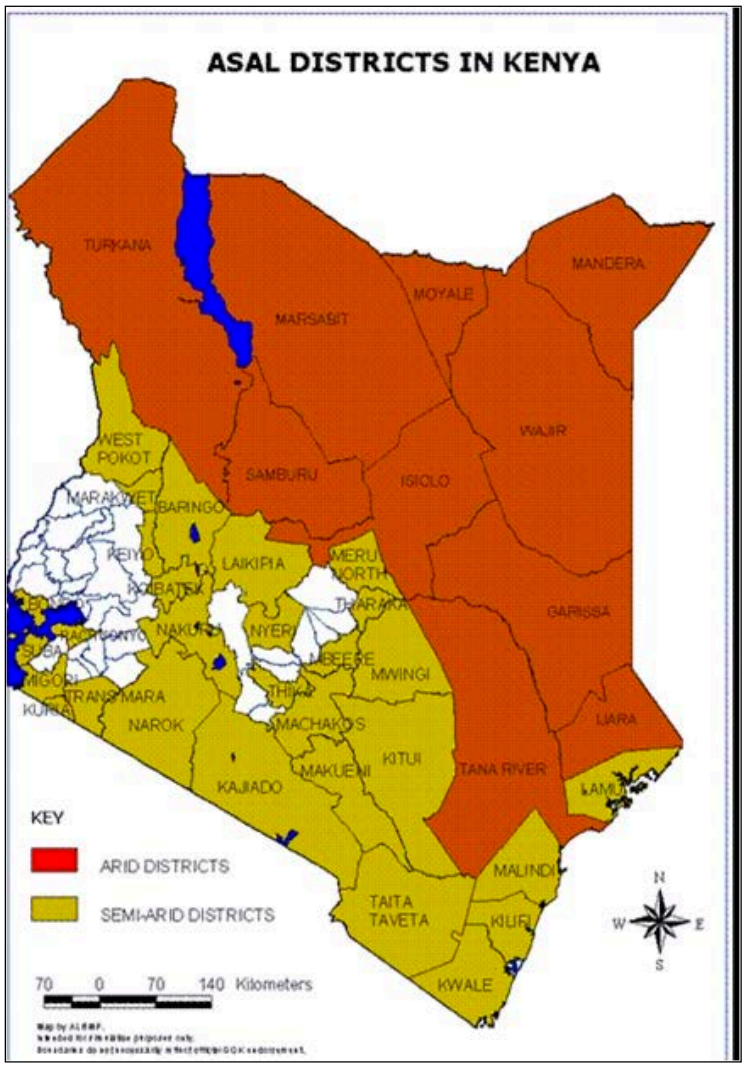
- Between 2006 and 2010 (namely 5 consecutive years), IBLI was able to insure 3.2 million animals.
- During the 2008 *dzud*, the total amount of compensation paid to herders amounted to USD 340,000, which were paid to 1,783 herders.
- At present, 5 insurance companies participate in the program and approximately 10% of the country's herders are insured.

3.3 THE NORTHERN KENYA EXPERIENCE

Strongly inspired by the program set up in Mongolia, the experience gained in northern Kenya since the late 2000s is particularly relevant for the purpose of this study. Indeed, like the Sahel, northern Kenya is a region dominated by extensive mixed livestock systems (cattle, camels, and small ruminants), whose mobility is also a basic management strategy, and which faces high climate variability. That said, an overly systematic parallel between northern Kenya and Sahelian countries should be avoided. In this part of East Africa, the topographic factor is more dominant (with the possibility of transhumance between high plateau areas approximately 800m above sea level and the low plains). In addition, there are two dry seasons and two rainy seasons with, consequently, different types of grazing and different production cycles. In the context of livestock insurance contracted on an annual basis, this also means that the year includes two potential compensation periods.

Supported by a multidisciplinary team involving the ILRI (International Livestock Research Institute, Nairobi), the American Cornell University and the Basis Research Consortium, the IBLI-Kenya was initially funded by USAID. Subsequently, a number of partners were added: The Universities of California and Syracuse, the Australian National University, APA Insurance, the African Reinsurance Corporation, DFID, and the EU.

Initially, the system was implemented in the Marsabit District, later extended to the Wajir and Isolo districts from 2014:



An initial assessment of available data allowed for several preliminary conclusions to be drawn. First, unlike in Mongolia, there were no reliable statistical data on livestock mortality over a long period. Secondly, there was, nonetheless, NDVI (Normalized Differential Vegetation Index) information for various vegetation indices that was available going back to 1982. Thirdly, USAID's PARIMA (Pastoralists Risk Management) project, begun in 1997 in northern Kenya and southern Ethiopia, had established a database for a dozen pastoralist communities in the Marsabit district. The information available at the family level covered a wide range of topics: the functioning of the pastoral system (quarterly data collected between June 2000 and June 2002), income profiles (household production and consumed goods, valued at market prices), and livestock products (milk, blood, meat) consumption.

However, this data was not sufficient to construct a reliable index establishing a strong correlation between the vegetation indices and livestock mortality rate forecasts. Thus, between 2000 and 2008, the experimental IBLI program integrated an additional data set from surveys conducted within the framework of two projects: IPAL (Integrated Project in Arid Lands) co-funded by UNESCO and UNEP in the early 1980s and ALRMP (Arid Lands Research Management Project), financed by the World Bank, which recorded monthly cattle mortality rates between 2000 and 2008. In addition to these, other surveys were conducted by the IBLI team among pastoral households.

A long and complex design work allowed for the establishment of a correlation between the vegetation indices and the projected rates of livestock mortality. Satellite data allow pastures to be measured every 10 to 16 days. This data is integrated in a predictive statistical model on livestock mortality rates. When the pasture situation indicates a projected mortality rate greater than 15% of the basic threshold determined for a specific area, the insurance systems compensates the insured herders from this area.

The IBLI only covers herders for livestock losses among camels, cattle, sheep and goats, resulting from drought. The contract insures the livestock for one year and includes two potential payout periods: at the end of the short and at the end of the long drought seasons. The contract contains a "trigger threshold" which is the mortality rate forecast beyond which the insurance begins to compensate the insured. Suppose, for example, that the trigger threshold is set at 15%. If the forecast mortality rate at the time of the compensation period was 35%, the insured would receive 20% (35-15%) of the value of the insured livestock.

Potential clients can only purchase this insurance during a two-month purchasing window, starting just before the rainy seasons. Indeed, at this time, they are unable to predict the climatic conditions for the coming season. The satellite images on which compensations are based are unfalsifiable, whether by the insurance company or by the clients, as they are collected by NASA and made freely available to the public. Thus, the system allows for the virtual elimination of any possibility of fraud.

> Let us take the example of a family living in Kargi (in the Marsabit district) who buys insurance for 10 TLU. The contract stipulates two parameters: firstly, the compensation value of each insured TLU and, secondly, the trigger threshold for the level of the index that will activate payments. If the declared value of a TLU is 15,000 Kenyan Shillings, then the herd would be valued at 150,000 Ksh. The period covered stretches from March to February of the following year. The payable premium is 3.25% of the total insured value (150,000 Ksh), amounting to 4,875 Ksh for the whole herd. This premium is also determined by the chosen trigger threshold, which is set at 15%. The family will receive no compensation, even if there are mortalities in the herd, when remaining below this threshold. Let us now suppose that, during the following

rainy season (in February), this rate rises to 25%. At that time, the family will receive a 10% compensation (25%-15%) applied to the total value of the insured TLU, or 15,000 KS (10% of 150,000 KS). All of the other herders in Kargi who have subscribed to the insurance will receive the same compensation.

The IBLI system began in January 2010 for herders in the Marsabit district. In October-November 2011, the first compensation was paid to those who had signed up for the insurance, at an average of 10,000 Kenyan Shillings (about 150 US dollars) per beneficiary family. In February 2014, a review of the situation showed that 27,000 families with a total of 340,000 TLU had subscribed to the IBLI insurance package.

3.4 THE CASE OF SENEGAL

Following the agro-sylvo-pastoral orientation law (2004), the Government of Senegal decided to explore insurance systems to address agropastoral vulnerability. Created in July 2008, following a favorable opinion of the CIMA Regional Insurance Control Commission (Commission régionale du Contrôle des Assurances - CRCA), the CNAAS is an insurance company which specializes in the coverage of agricultural risks. Funded with a capital of 1.5 billion FCFA, the company brings together the Government of Senegal, various Senegalese insurance and reinsurance companies, producer organizations (e.g. the Federal Cooperative of Horticultural Producers of Senegal and the Groundnut Producers national network), as well as Senegalese private actors. The CNAAS is reinsured by SWISS-RE (Swiss Reinsurance Company, Ltd., based in Zurich).

As such, the CNAAS currently offers a relatively high diversity of insurance products (see the following page).

As regards insurance related to the harvest of agricultural produce, 4 guarantee options are offered:

- Full risk cover (covers crop losses based on expected returns);
- Multi-risk cover (covers crop losses due to the major agricultural risks);
- Agricultural multi-risk (covers agricultural producers against the various risks which they face);
- Index-based harvest (covers crop losses indexed on the basis of rainfall or expected yields).

ASSURANCES RECOLTES

ASSURANCE MULTIRISQUE EXPLOITATION AGRICOLE

Elle couvre le patrimoine et l'activité de l'exploitation agricole contre les risques d'incendie, de bris de machines, de vol et de tous autres dommages aux biens suivants :

- Les bâtiments et leurs annexes,
- Les équipements, installations et aménagements agricoles,
- Les matériels, mobiliers et agencements,
- Tous autres investissements.

Les garanties peuvent être étendues à l'autre type de périls spécifiques moyennant surprime.

ASSURANCE TOUS RISQUES RECOLTES

Elle garantit une couverture complète des calamités naturelles suivantes :

- Sécheresse
- Feux de brousse ou vague de chaleur
- Inondations ou pluviométries excessives
- Invasion acridienne

Les tarifs varient en fonction du département, du taux de couverture, du niveau de rendement moyen et de la nature de la récolte.
Ils sont exprimés en % de la valeur déclaré de la récolte et vont de 1,5% à plus de 10%

ASSURANCE POUR RECOLTES SPECIFIEES

Elle garantit une couverture à la carte des calamités spécifiques pouvant atteindre l'exploitation telles :

- La pluviométrie excessive
- L'inondation
- Les dommages causés par les animaux sauvages
- Tout autre dommage assurable pouvant atteindre l'exploitation.

Les tarifs varient en fonction de la nature des risques encourus par les récoltes concernées et sont en % de la valeur déclarée de la récolte. Ils vont de 0,5% à 1%.

ASSURANCE DEFICIT PLUVIOMETRIQUE

Elle offre une protection contre les conséquences de déficit pluviométrique sur la protection agricole durant la saison des pluies. Elle rembourse la perte de récolte induite par une pluviométrie en deçà d'un niveau considéré comme seuil de déclenchement.
Les tarifs vont de 1,5% de la valeur de la récolte à 15%

ASSURANCE MORTALITE DU BETAIL

ASSURANCE MORTALITE DU BETAIL TOUS RISQUES

Elle offre à l'éleveur une garantie contre les risques de mort naturelle ou par accident du bétail et d'abatage autorisé. Les tarifs pour une couverture annuelle varient en fonction du type de cheptel. Ils vont de 6% à 9% de la valeur de l'animal.

ASSURANCE MORTALITE ACCIDENTELLE DU BETAIL

Elle offre à l'éleveur une garantie contre les risques de mort accidentelle de bétail. Les tarifs pour une couverture annuelle varient en fonction du type de cheptel. Ils vont de 2% à 3% de la valeur de l'animal

ASSURANCE MORTALITE VOLAILLE

Elle offre une garantie contre les risques de mort de la volaille résultant d'accident ou de maladie. Les tarifs pour une couverture annuelle varient en fonction de la nature et de la période d'élevage. Ils vont de 1,75% à 3%

ASSURANCE MULTIRISTIQUE PROFESSIONNELS VIANDES

Elle garantit aux bouchers et chevillards sollicitant régulièrement les prestations des services des abattoirs de la SOGAS (Société de Gestion des Abattoirs du Sénégal) une indemnité contre les risques des saisies totales ou partielles des animaux abattus pour des motifs qui ne leurs sont pas imputables.
Les tarifs vont de 3 à 5 F par kg du poids de la carcasse.

ASSURANCE COUVERTURE DE PRETS

Il s'agit d'un produit d'assurance couvrant les risques de décès, d'invalidité, de perte d'emploi ou d'activité professionnelle en vue de servir de garantie au remboursement des prêts consentis par une banque ou institution de microfinance à des clients emprunteurs.

LES PROGRAMMES SPECIAUX

ASSURANCE MULTIRISQUE VEHICULE HIPPOMOBILE

L'Assurance Multirisque Véhicule Hippomobile garantit une indemnité en cas de dommages accidentels subis par le véhicule hippomobile (le cheval et la charrette) et des dommages matériels causés à autrui par le véhicule.
La prime pour une couverture annuelle est en moyenne de 25.000 F par véhicule hippomobile.

ASSURANCE INDICIELLE ARACHIDE ET MAIS

Elle couvre les producteurs d'arachide et de mais contre les risques de sécheresse et de déficit pluviométrique selon des formalités allégées et un tarif en conséquence. Pour la campagne 2012/2013, elle est proposée aux producteurs des régions de Kaolack et de Kaffrine. Elle sera élargie à d'autres spéculations et à d'autres spéculations et à d'autres localités à partir de la campagne 2013.

ASSURANCE OIGNON ET TOMATE INDUSTRIELLE

- L'assurance «**oignon**» couvre les producteurs des Niayes contre les risques de vagues de chaleur excessive, «neige» ou embrun marin, pluies hors saison, invasion de criquets pèlerins et pourriture du collet.

Le tarif est fixé en % des charges de production.

- L'assurance «**Tomate industrielle**» couvre les producteurs de la vallée du fleuve Sénégal contre les risques de dégâts causés par les animaux sauvages, vagues de chaleur, inondation, pluies hors saison et dégâts causés par les oiseaux sauvages.

Le tarif est fixé en % des charges de production.

Ces deux produits seront étendus aux autres zones de production du Sénégal.

Source : CNAAS Institutional Brochure

Initially focused on the groundnut basin, index-based insurance mainly covers maize and groundnut production:

As regards livestock insurance, the products on the market remain traditional and cover various risks, with particular emphasis on accidental mortality (bushfire, poisoning, drowning, collision with a vehicle). Compensation is set at between 2% and 8% (in the case of comprehensive insurance) of the value of cattle, against 9% for horses, 6.5% for sheep and 6% for goats. In the event of a loss, compensation corresponds to 80% of that value. Under the current system, premiums are subsidized at 50% by the Government.

After 4 years, it is estimated that the portfolio developed by the CNAAS represents approximately 500 million FCFA for all agricultural insurances, of which nearly half is made up of livestock insurance. As is the case with rice production along the Senegal River Valley, interventions planned in the livestock sector (funds for animal stabling and fattening) will make obligatory this type of insurance as a requirement for obtaining credit.

Livestock insurance here is tailored to the specific animal which is being insured, and which must undergo initial examination by a veterinarian, including an assessment of its health status and its market value. Until now, these products have mainly been designed to cover the needs of sedentary and peri-urban livestock producers, especially to insure high yielding animals and, in particular, exotic breeds. These animals are generally kept in corrals.

More recently, the CNAAS has become interested in further developing livestock insurance to also cover extensive livestock production, developing an insurance package linked to use of livestock feed and strongly anchored on several herders' organizations and on Borehole Users Associations (Associations d'Usagers de Forage - ASUFOR), some of which have access to warehouses. Animal feed is purchased from manufacturers (SEDIMA, New African Milling – NMA) and transported on-site.

The system is fairly simple. For each bag of animal feed purchased by a herder at the "normal" price, a sum equal to 10% is set aside and invested in insurance for an animal. One bag thus covers the insurance of a small ruminant and eight bags are enough to insure one head of cattle. Overall, the rate of the premiums is equivalent to conventional insurance.

The effort made by the CNAAS reflects a strong commitment to break into the pastoral production systems, and to offer an interesting product to a larger number of producers, even though the product itself remains traditional, without any connection to climatic events. It will be therefore important to follow this experiment and analyze the capacity of conventional insurance products to adapt to the constraints faced by herders. For example, how to reconcile monitoring and sanitary controls with the movement of animals over long distances, and without handicapping pastoral mobility, including cross-border mobility?

In addition, several factors should also be taken into account before drawing conclusions:

- At the scale of a herd comprising 50 heads of cattle, going on transhumance, the cost of insurance can be high, with an average premium of 7 to 8,000 FCFA per year for one animal.
- The assessment of the insurable value of an animal can pose practical difficulties, because the animals are not sedentary. Their weight and, therefore, their value changes significantly between the dry and the rainy season, and plummeting dramatically during periods of crisis. The reference value for insurance purposes should thus be updated during the year and reassessed accurately.
- The use of livestock feed may be relevant as an entry point to pastoral systems and as a mean to familiarize herders with livestock insurance. However, how sustainable will the insurance product be, once the subsidy system is removed?

Finally, the promotional materials used should also be looked at. On the one hand, livestock feed remains a product mostly intended for intensive livestock operations (milk, fattening, peri-urban), including for poultry. On the other hand, the availability of animal feed is necessarily limited. A recent study on the availability of agro-industrial by-products in several Sahelian countries reveals that in Senegal, there is always a theoretical potential for increasing agro-industrial by-products (AIBP) availability (particularly with current imports in Senegal of wheat, instead of already processed flour); nevertheless, the main limits to such an increase remains in raw material limitations, since the amounts of available AIBP are unlikely to increase substantially in Senegal in the coming years.[14]

[14] **Lambaré Pierre**, 2015, *Potentiel de sous-produits agro-industriels en Afrique de l'Ouest : cas du Sénégal, du Mali et du Niger, CIRAD-Pôle Pastoralisme et Zones Séches* (Dakar)-AgroParis Tech.

4. EMERGING DEBATES AND KEY ISSUES

4.1 CONSTRUCTING THE INDEX: MULTIPLE AND COSTLY CHALLENGES AHEAD

An overview of experiences in terms of index-based insurances clearly shows the importance of the investment required for the design of climatic indexes and, consequently, the prominence given to this issue in the literature on microinsurance, often at the expense of other considerations such as the impact of insurance on poverty reduction.

The issues raised are significant:

- It was noted that, in the absence of sufficient data in terms of volume and quality, it is impossible (or very risky) to build an index. Without an adequate index that is objectively verifiable, non-falsifiable and that remains relevant over time, insurance and reinsurance operators are unable to provide products for which they would be prepared to assume the risk. The whole structure would come crashing down.
- The index chosen must be up to the task of reducing as much as possible the basis risk by establishing a high covariance between the insured risk and its impact on the types of production being insured. It is therefore necessary to conduct highly precise surveys at the household level, which is an expensive and lengthy operation.
- The index must be easily measurable, accessible and non-falsifiable, with an accurate measurement of possible margins of errors, which must be quantifiable for companies.

The establishment of an index thus implies taking up several challenges at once. This is well illustrated in Senegal, where an IFAD-WFP-WRMF project[15], with funding from the AFD (2012-2016) is currently working on the feasibility of satellite technology as applied to index-based agricultural insurance for small farmers in the groundnut basin (Kaffrine). The research carried out has identified several limiting factors:

- The farms are small and contain several different agricultural productions.
- The variability of rainfall and crop harvests is significant; even within small areas, there is a great heterogeneity in terms of the situation at the level of individual farm.[16]
- The cloud cover often present during strategic stages of plant growth is a handicap.
- The cost of raw satellite data at the local level and its processing is significant, and the qualitative data from long, uninterrupted and disaggregated series at the local level are not sufficiently available.
- The calibration of the area to be insured is crucial in order to manage the basis risk while, at the same time, avoiding increasing administrative and management burdens for the insurance.
- There is a lack of meteorological stations in sparsely populated areas, and in those areas that are close enough to the areas to be insured; a high number of additional stations, as well as their attendant expenses, (implementation costs, long-term maintenance problems) would need to be planned for.

[15] Weather Risk Management Facility, joint initiative of IFAD and the World Food Programme (WFP).

[16] The problem of the heterogeneity of local situations in rural areas was also reported by the World Bank in India, where the diversity of productions and the variability of harvest levels were serious handicaps to the implementation of a WBCIS (*Weather Based Crop Insurance Scheme*). Added to this is the fact that localized weather events (e.g. hail or flood due to the overflow of a nearby river) have no impact on the whole of the insured area and are therefore not covered by index-based insurance.

As such, considerable work is required for the insurance system to be based on a clear, solid and precise correlation between the index measurement made and the losses incurred by producers. It is a challenge that involves establishing a dialogue with the scientific community: how can a drought be measured? what is the maximum distance which a household (whether agricultural or pastoral) may be located from a rain measurement system in order to ensure that there is still a close link between rainfall measurements and the real deficit situation faced by this family?

The development of an index is therefore, as shown in the Kenyan experience, a long, complex and costly process, particularly in situations where there are no reliable databases which can provide uninterrupted series of information over long periods of time. Compared to other countries, Mongolia had the major advantage of having accurate annual livestock censuses dating back to the early 1920s.[17] For this reason, the index developed in Mongolia could be strong and therefore managed to convince the private sector to engage in this type of insurance. Without such a database, the risk would have been taken to implement an insufficiently reliable index, implying a high baseline risk: in some years, the compensation paid by the insurance companies would not have helped to relieve herders in case of *dzud*, while in other years, these companies would have had to pay out a large number of claims, which would not have been viable for them.

The construction of an index in Mongolia was thus made possible by the availability of accurate data on livestock mortality. This was not the case in northern Kenya. It would be even less the case in the context of the western Sahel. A recent study conducted in Niger[18] noted that for the agricultural zones, the implementation of an index based on a rainfall deficit index would require the installation of an additional 75 meteorological stations in the south of the country (of the AWS type[19]). As for the pastoral zone, the study indicates the lack of reliable statistical data on livestock production and mortality, underlining the need for additional detailed studies, and to continue to invest strongly in climate data infrastructure in the north.

In the Sahel, resorting to vegetation measurements also raises important questions. While the production of biomass depends mainly on rainfall, the distribution of rainfall, both in place and time, is critical. A high variability of rainfall also within the zone, with localized rainfall patterns, is common, leading to a similar variability of pasture resources, sometimes over distances of no more than a few kilometers. Similarly, annual rainfall can thus produce a very different biomass production. Rainfall can also be inversely proportional to the nutritional value of the grass cover. Heavy rainfall produces abundant biomass. However, beyond a certain threshold, the nutritional value begins to decrease due to the dilution of nutrients and the lignification of the stems. As such, a very rainy year does not automatically mean a good year for pastoralists. Ultimately, how the rainy season starts, the duration of this rainy season, as well as the dry spells present during it are all factors that determine the amount of grazing biomass on the range lands to which the herds have access.

In the context of Sahelian livestock production systems, rainfall is a key factor influencing the level of annual primary (biomass) production, and, consequently, the appropriate stocking rates for the following dry season. The regular monitoring of rainfall during the rainy season provides strategic information on the distribution of fodder resources in a given area or country, as well as providing information on dry spells leading to pockets with

[17] Since the creation of IBLI, censuses now even take place biannually.

[18] **RSMI-India et le World Bank Group**, 2013, Implications du secteur privé pour renforcer la résilience de l'agriculture du Niger aux changements climatiques : évaluation du marché de l'assurance agricole.

[19] Automatic Weather Station

fodder shortfalls. The standing biomass at the end of the growth period represents the fodder stocks available for livestock, which must cover its needs during the 8 to 9 months of the dry season. This biomass is generally assessed around October. Over the past 20 years, the evaluation methods have evolved and now tend to combine ground surveys with data from satellite imagery.

Based usually on a wide-ranging census of the existing herd, the number of TLU to maintain during the dry season allows main deficit situations to be identified. For instance, in Niger, the annual assessment of the agropastoral production compiled by the Ministry of Livestock provides key information on the available biomass for every region of the country, quantified in tons of dry matter, as well as on the estimated volume of crop residues and fodder contributions from the southern pastoral enclaves located in the agricultural zone. For the year 2013-2014, the overall fodder deficit was estimated at 6.7 million tons of dry matter, resulting in serious problems of malnutrition for around 30% of the national herd. The average biomass was 758kg of dry matter per hectare (versus 1.49 tons the previous year), with a serious deficit in the east of the country (only 176 kg/ha).[20]

Even if the assessment of the available biomass does not take into account all parameters relating to the quality of the pastures (floristic composition, for example), its estimated annual capacity allows for the assessment of the magnitude of livestock movement likely to occur in the following months. In this way, in a relatively good year, an area of 8 to 10 hectares is sufficient to cover the nutritional needs of one TLU (equivalent more or less to one adult bovine). However, in a bad year, it takes around 20 hectares, and up to 100 hectares during a drought. Beyond a certain threshold, an animal eventually loses more energy by walking than it gains by consuming what little grass is available. Moving thus becomes a priority for herders and the intensity of pastoral movements is directly linked to the magnitude of the climatic shock. In fact, in good (and even more in bad) years, mobility is a basic risk-management strategy which allows herders to take advantage of different grazing opportunities in different locations. The index must thus be able to integrate this essential dimension, a task made even more difficult since the movement of the livestock systems, and the strong interweaving of the livestock mobility axes between the Sahelian and coastal countries, constantly requires expanding the scope of observation on a cross-border basis.

The concept of available biomass must also be complemented by several very important elements. Over the past 50 years, the availability of forage has been significantly reduced, not because of climate, but because agricultural activities have increasingly taken over more space. The reduction of rangelands in the north and in the southern agropastoral and agricultural regions is a striking change. As such, the mobility of pastoralists and agropastoralists is often triggered more by a lack of resources in areas where they are located than by a climatic event per se. For herders, risk is thus not climate-based, but rather linked to the expansion of agriculture. In some regions, the expansion of land-clearing for agricultural encroaching onto grazing areas results in an increase in transhumance departures, longer transects and an increasing number of animals departing.

The development of livestock systems in agropastoral and agricultural areas, as well as the close links between crop cultivation and the natural rangelands in many Sahelian countries makes a reliable interpretation of NDVI (Normalized difference vegetation index) data difficult; the more so, as separating pastoral biomass from cultivated biomass which is not available to animals, is challenging. In addition, it is difficult to take into account the contribution of trees (leaves, fruits, pods, seeds) which forms an essential element in animal nutrition.

[20] **Government of Niger**, Ministry of Animal Resources, 2014. Annual assessment of the agropastoral production 2013-2014, Niamey.

Moreover, because of pastoral mobility and the practice of transhumance through which herders access a vast range of resources, the assessment of nutritional resources available should also incorporate the contributions made by agricultural byproducts. These include: high-value crop residues from cowpeas and groundnuts, as well as roughage such as millet and sorghum stalks. To this needs to be added the important contribution made by household food residues (such as millet or sorghum chaff) which are essential inputs for those animals with a key role in the family herd (animals for fattening, lactating females). Finally, the resource assessment needs to include the contribution of livestock feed (wheat bran, pressed seed-cake, cotton seed).

4.2 THE PERSISTENCE OF BASIS RISK

Controlling basis risk depends to a large degree on both the fine-tuning and the relevance of the index used. Nonetheless, many shortcomings persist.

In terms of agricultural production, index-based insurance is likely to be relevant in the context of intensive agricultural systems (monocultures, high density land-use). However, more traditional farming practices show a considerable variability in yields and in local disparities, not only within the same region, but even from one farm to another, as was demonstrated by the study conducted in Senegal. As such, with the exception of large-scale and high intensity weather events, these systems are characterized by significant localized variations. Thus, for medium to wet years, establishing a climate index based on a high covariance with crop yields remains difficult.[21]

These limits are even more apparent for pastoral and agropastoral farming systems. The quantitative and qualitative data generated on the ground (Mongolia, Kenya) clearly show the volatility of situations encountered by herders, as well as the extreme heterogeneity of the production systems, and the situation of pastoral and agropastoral families before and after a crisis. This finding is also confirmed by post-drought studies (1984[22],1992) conducted at the household and family herd levels. The diversity of situations encountered at the household level requires complex and costly study, which needs to be updated constantly, both upstream and downstream of the development of the insurance product.

All of this has several implications:

- A reliable correlation that remains difficult to establish between the trigger level for compensation, and the actual performance levels in terms of production.
- A basis risk at the producer level which remains high.
- A high "reputational" risk for the insurer or reinsurer in loss situations at the producer level where no insurance is paid, as producers will continue to experience difficulty in understanding the insurance system.

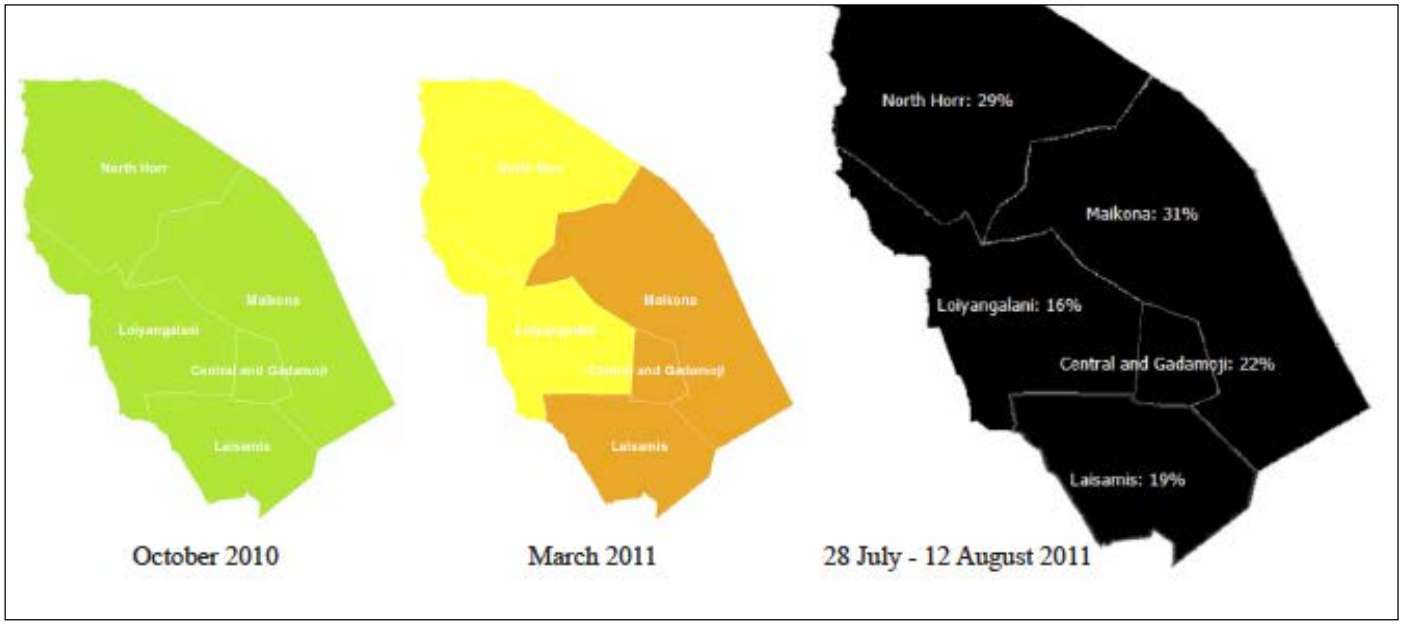
Such limits are equally valid, if not more so, in the context of livestock insurance. For northern Kenya, Carter, Long and Mude reported that in 2011, the forage situation in the Marsabit district began to show deficits following a poor rainy season. However, although the satellite data confirmed this trend, the projected mortality rates generated by the statistical model remained below the trigger level for compensation because of the good

[21] **Muller B., Sall M., Leblois A., Balde A., Fall M., Kouakou P., and Affholder F**., 2013, *L'assurance indicielle en Afrique de l'Ouest : principes, premières réalisations et perspectives, Agronomie Africaine Numéro spécial (6) sur les changements climatiques* : 95 - 111 (2013)

[22] **THEBAUD B, et NOMAO A.,** 1987, *L'aménagement de l'élevage dans le Département de Diffa : bilan des systèmes de production après la sécheresse de 1984*, Projet de Développement de l'Elevage dans le Niger Centre-Est (PDENCE), Ministère des Ressources Animales, Niamey.

condition of the animals at the end of the previous season and hence their ability to get through a coming difficult period. While a certain amount of livestock mortality was certainly expected, this was not in sufficient number to warrant compensation; an announcement which was very poorly received by the herders. The mathematical model used is, in fact, very reliable when it comes to a major crisis causing widespread mortality, but it is much less precise on a smaller scale, particularly at the level of individual pastoral households. As a result of this, a system using colors was subsequently introduced to help herders understand the concept of critical thresholds, going from green (good and stable situation), to yellow (good but deteriorating situation), orange (moderate crisis), red (severe crisis) and finally black (very severe crisis)[23]. These codes are displayed every 15 days in the insured zones of the Marsabit district.

For the 2010-2011 period, the situation was visually represented as follows:



In the final analysis, the preparation of an index based on a perfect correlation with agricultural or pastoral risk remains a problem. Even if such an index were possible, the moral hazard that prevailed in traditional insurance would eventually be replaced in index-based insurance by a non-equity payment, or simply an unjust enrichment, as insurers are always confronted by situations in which an insured person who has suffered losses is not compensated, while another insured person, who has not suffered losses, is.[24]

Several avenues continue to be explored in order to limit basis risk:

- Limit index-based insurance to infrequent weather events with high covariance which will strongly impact the majority of the population.
- Invest in climate modeling or in the number and distribution of meteorological stations in order to better integrate the variability of local conditions. However, these investments are expensive. In addition, a new meteorological station unfortunately

[23] **CARTER M., LONG E., MUDE A.**, 2011, The IBLI Color Legend: Translating Index-Based Mortality Predictions into Meaningful Signals, Index Insurance Innovation Initiative

[24] **NDIAYE A.**, 2012, *L'assurance agricole au Sénégal, un système en construction, présentation faite dans le cadre du Colloque FARM-Pluriagri : assurer la production agricole, comment faire des systèmes assurantiels des outils de développement ?* Paris, December 18th, 2012

cannot provide any climate history for a specific area, which is a major handicap for the construction of accurate indices to reduce basis risk. The increasing use of remote sensing data offers other possibilities, with indices which can be evaluated remotely, using satellites. However, the interpretation of this data continues to pose technical difficulties, and farmers and herders continue to demonstrate a reluctance to accept that the payment (or non-payment) of their compensation be based on "invisible" data which does not correspond to their own observations.

4.3 Index-based insurance: truly a cheaper product?

The cost of insurance is a critical factor. It must be low, to attract a large number of producers and must also, in case of disaster, be able to ensure that a critical mass of those insured benefits. For livestock insurance, this cost must also remain low in order to encourage herders to insure a significant portion of their herd. However, in Mongolia, at present, it is estimated that, those who have subscribed to the insurance only insure 30% of their herd.

It should also be possible to modify the cost of insurance depending on circumstances. For example, in Mongolia, the price of cashmere, which is an important source of income for herders, fell by 50% between 2008 and 2009, which affected their ability to purchase insurance policies.

Finally, in order to keep the premiums as low as possible, the "administrative infrastructure" must be extremely effective. The promotion, sale and purchase of insurance policies must be based on the simplest and fastest possible process, for example by going through banks or mobile phone service-providers. IBLI-Mongolia has also tried to offer herders a premium reduction if they accepted the principle of automatic renewals (thus avoiding a repetition of transactions) but, so far, they have remained reluctant to do so.

At the outset, index-based insurance is usually much less expensive than traditional insurance, due to reduced transaction costs. However, several factors can counter this principle. The uncertainty associated with climate change could result in an augmentation of premiums having to be paid by producers in the future, with insurers forced to bear risks associated with events for which they do not control the degree of recurrence.

Moreover, it is not clear that the major advantage of index-based insurance, namely the reduction of transaction costs, can be confirmed in practice, if we tally all of the operations from the point of product development to final claims processing. Indeed, a comparison with traditional insurance products tends to show that, even if the adjustment costs are indeed lower, the fact remains that:

- The cost of development of index-based insurance products is much higher than for a traditional product;
- The costs associated with its marketing and sale are far from negligible, and probably comparable with traditional insurance;
- The policy management costs and administrative costs for compensations are not necessary affordable (Herbold, 2014).

4.4 A limited understanding of impacts of livestock insurance on livelihood systems and poverty reduction

The IFAD study (2010) on the development of index-based insurance stresses that few programs really look at their impacts in terms of improving living standards and reducing poverty. While there are certainly data available on the positive effects in terms of production improvement, easier access to credit and increased investments by producers,

few studies have been conducted retrospectively showing how insurance has changed the income and livelihood strategies of agricultural producers, or the ways in which the protection of lives and assets has enabled people to escape poverty.

IBLI-Kenya has tried to break away from this pattern and has, through surveys, provided a number of key insights. After the first compensation payouts in October-November 2011, a random sample of 924 pastoralist households (who already knew that they would receive compensation) was investigated to determine the impacts: how had they coped with the crisis over the 3 preceding months, and how did they foresee the coming months? These surveys showed that insured household reported a 33% decrease in the probability of reducing their nutritional intake, a 50% drop in the forced sale of livestock, and a 33% drop in their food aid dependency. Nonetheless, the study stressed that these results should be approached with caution, since at that time, the herders interviewed knew that they would receive compensation. Consequently, insured households could easily declare that they anticipated to reduce their sales of animals and not reduce their food purchases despite the crisis, thus maintaining their level of consumption. For the rest, surveys show that the impacts of IBLI can only be analyzed over several years and that it remains difficult to integrate the diversity of pastoral situations specific to each household before a crisis.[25]

Pastoral systems are characterized by uneven livestock herd growth patterns. During the periods of herd decline, herders report loss of revenue. However, good years provide the opportunity to reconstitute the herd and create reserves. IBLI's research team has thus devoted considerable effort to determine the points of "bifurcation" in the dynamic between the herd and the family, that is to say, the critical threshold below which a household falls into a cycle of poverty from which it is hard to escape. A series of surveys was implemented to study this. Workshops were also held with herders, involving relatively complex roleplaying games, led by facilitators trained for this purpose.[26]

The studies show that the initial size of the herd before the crisis constitutes the key element which determines both the level of vulnerability of the household as well as the real utility of subscribing to a livestock insurance. One of the conclusions drawn emphasizes that, for the most vulnerable households, with a herd below the viability level, the establishment of safety nets (money transfers, subsidies) forms an essential operation upstream of an insurance system, in order to enable them to increase their livestock capital and rise above the critical threshold. Such an approach also requires investment in supporting crisis management strategies used by pastoralists (animal health and mobility support, for example), as well as the carrying out of detailed investigations in order to identify where these vulnerable households are to be found.[27]

On this basis, a careful review of the IBLI's impact was conducted in 2014, from which 4 scenarios clearly emerge:

- For the poorest households whose herd sizes are well below the critical herd size threshold, IBLI's contribution to the household economy is minimal. Coverage in case of a bad year may improve the situation, for instance insurance payment increasing the household's capacity to purchase fodder supplements on the market. However, payment

[25] **Carter, M., Long E., Mude A**. (2011) "The IBLI color legend: Translating Index Based mortality predictions into meaningful signals". I4 Brief no. 2011- 02, July.

[26] **Carter, M. R., Barrett C. B., Boucher C., Chantarat S., Galarza S., McPeak J., Mude A. G. and Trivelli C**. (2008) "Insuring the never before insured: Explaining index insurance through financial education games; M**cPeak, John, Sommarat Chantarat, Andrew G. Mude** (2010) "Explaining Index Based Livestock Insurance to Pastoralists," *Agricultural Finance Review*, Vol. 70 Iss: 3, pp.333 – 352

[27] **Chantarat, Sommarat, Andrew G. Mude, Christopher B. Barrett and Calum G. Turvey**, (2014) "Welfare Impacts of Index Based Livestock Insurance in the Presence of a Poverty Trap." June

of a premium year after year will end up decreasing the herd size, thus pushing further downward the vulnerability of the household. Since households in this cohort converge to the low-level equilibrium with or without insurance, IBLI offers them relatively little in the way of economic relief. Other instruments are better suited to meet their needs.

- Those households whose herd sizes are just marginally above the herd threshold expect to grow their herds if the season is good and if they do not pay the insurance premium. For these households, paying the insurance premium may actually drop them below the threshold. Consequently, IBLI can have adverse consequences to herd growth dynamics for this subpopulation.
- Vulnerable households are those whose herd sizes are modestly above, but still vulnerable to the risk of falling below, the critical herd threshold. IBLI can protect vulnerable households from falling below the poverty trap threshold in the wake of adverse insured shocks. IBLI can thus offer especially favorable dynamic impacts by keeping the household on its herd growth trajectory.
- For the non-poor households with herd sizes so large that even without insurance they are not expected to fall below the critical herd threshold after covariate shocks, IBLI would not alter their herd dynamics, just as was the case with the first cohort (with the smallest herds).

In short, the growth dynamics of a herd is not linear and requires time. The initial situation is thus absolutely crucial. If a herder does not have a surplus of livestock capital, above the critical threshold, which allows him to pay insurance premiums year after year without threatening the growth of the herd, he stands to benefit. For all other situations, either insurance carries with it the risk that it will have the opposite effect (for moderately to highly vulnerable households), or has little utility (for affluent households).

4.5 Insurance systems that remain heavily subsidized

Until now, index-based insurance systems in developing economies have been very heavily subsidized, both upstream (development of the indices) and downstream (promotion and sale of the products, payment of premiums). Such a finding is true not only in the case of the IBLI in Mongolia, but also in Kenya and Ethiopia where all of the components of the system have received significant subsidies from the government and from the donors. There is also a high level of external inputs in the mechanisms in place to underwrite governments against the impact of natural disasters.

The rationale is that the development of the product requires significant resources which involves costly field research, particularly for the development of the index and linking this with the household economies of (potential) future beneficiaries. Moreover, it is widely assumed that index-based insurance will require subsidies in the early stages of its development, before producers have the means to fully bear the costs of maintaining the system.

However, there remain several concerns. Subsidies awarded for the payment of premiums (such as in Senegal, where producers only pay 50%) are often granted to all clients, even those who have sufficient resources to pay the full premium required by the insurers. To resolve this problem, there should be a socio-economic classification of family farms on which to base the decision to grant the subsidy. However, this implies either carrying out detailed investigations or relying on the statements of the producers (hence the reinsertion of moral hazard in index-based insurance).

Moreover, subsidies may have a deterrent effect on the future purchase of non-subsidized (insurance) products, contributing to excluding private insurers that receive no governmental subsidies, in a sector where governments are required to provide equitable conditions for all actors.

4.6 INSURANCE PRODUCTS MAINLY BASED ON SUPPLY, WHILE DEMAND REMAINS LOW

Index-based microinsurance carries with it the implicit promise of being able to reach the masses. In fact, in India, insurance systems associated with a weather index or a crop yield index have been in use for a long time, which is why today millions of producers are covered by these types of insurance.[28] However, outside of India, it is clear that index-based insurance has barely begun to be accepted, faced with a demand which remains limited.

In the context of southern Ethiopia, Takagashi, Ikegami, Sheahan and Barett (2014), point out that the promise offered by index-based microinsurance, namely to revolutionize the world, has not come about, and that the products offered have rarely reached more than 30% (and often much less) of their target beneficiaries. All of these findings make it necessary to either rethink the products on the market, or thoroughly re-examine their performance.

The same researchers also raise the paradox posed by herders, whose level of risk, being higher than that of farmers (a herd takes years to recover, while a farmer can rebuild his crop base once a drought is over), would suggest that they would be more likely to seek insurance, which is not the case. Part of the answer is to be found in the fact that affluent herders do not need insurance, since they have access to several strategies for coping with climate risk, while poor herders do not have the means to pay for insurance. Between these two categories, the class of herders who has the means to both afford insurance and benefit from it, ultimately remains a narrow niche that must constantly be evaluated and updated.[29]

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[28] These programmes fall under the umbrella of the State. Regional authorities choose the insurance programmes for the producers who pay between 25 to 40% of the insurance premiums; what remains (between 60 and 75%) is subsidized by the government. The *National Agricultural Insurance Scheme (NAIS*) was set up in 1999 following on from an initial crop insurance programme (*Comprehensive Crop Insurance Scheme-CCIS)* which had been set up in 1985. This programme was compulsory for all producers receiving credit and covered staple food crops, oil-seed crops and a selection of commercial (cash) crops. The index is linked to harvests at the district-level. The state-sponsored company (*Agriculture Insurance Company of India*) disburses indemnities on a pro rata basis linked to the level of the premium paid by the producer, with the State paying the difference. Subsequently, the *Weather-based Crop Insurance Scheme (WBCIS)* was introduced in 2003 on an experimental basis in the Andhra Pradesh. This scheme insured some forty different categories of crop production against a number of risks, including excessive rainfall, drought, falling temperatures, and wind. In 2013, the WBCIS insurance covered some 13 million producers. (**Greatrex et al**., 2015 op.cit.).

[29] **Takahashi K., Ikegami M., Sheahan M., Barret C**., 2014, Quasi-experimental Evidence on the drivers of Index-Based Livestock Insurance Demand in Southern Ethiopia, Institute of Developing Economies.

Case study	Country	Commodities	Start date	Number of insured	Key features
NAIS *National Agricultural Insurance Scheme* **mNAIS** *modified National Agricultural Insurance Scheme* **WBCIS** *Weather-Based Crop Insurance Scheme*	India	Cereals, millets, pulses, oilseeds, annual commercial horticulture	1999	16.79 million under NAIS, 3 million under mNAIS 13.62 million under WBCIS (2013)	State-subsidized insurance programmes, bringing insurance to millions of farmers through a link with agricultural credit.
ACRE *Agriculture and Climate Risk Enterprise (formerly Kilimo Salama)*	Kenya, Rwanda, Tanzania	Maize, beans, wheat, sorghum, coffee, potatoes	2009	Over 187,466 60% in Kenya, 40% in Rwanda (2013)	Strong links to aggregators and mobile technology. Wide range of products, mostly linked to credit or inputs.
R4 *Rural Resilience Initiative (formerly HARITA)*	Ethiopia, Senegal	Teff, beans, maize, wheat, barley, sorghum, millet	2009	24,133 in 82 villages in Ethiopia 1989 in Senegal (2014)	A farmer-led, integrated risk management project, with labour for insurance and satellite rainfall indexes.
IBLIP *Index-Based Livestock Insurance Project*	Mongolia	Livestock (camels, cattle, sheep, goats and horses)	2006	Approximately 15,000 herders (2014)	A public-private partnership with innovative risk layering, within a diversified risk management portfolio.
IBLI *Index-Based Livestock Insurance*	Kenya	Livestock (camels, cattle, sheep, goats)	2010	Approximately 3000 contracts sold during the project lifetime	Creative education methodologies and an innovative mortality index-based on NDVI.

Source: Greatrex H., et al., 2015, op.cit.

Added to this is surely the fact that index-based insurance products are complex and, therefore, difficult to explain in a convincing manner, and consequently, making it hard to generate an informed debate with the target beneficiaries. This difficulty is especially large in countries where herders are illiterate and have little experience with insurance. From this point of view, the situation in Mongolia was very favorable, due to the very high literacy rate in the country. The promotion of index-based insurance could be done through a variety of information channels: television, advertising pamphlets, and information sessions in the rural areas. This would not be the case in the Sahel.

It is therefore not surprising to see, in some places, the impression of a kind of professional exhaustion. Recently, under the banner of CGIAR's ILRI, Australian Aid, DFID and the EU, the IBLI network has launched a competition to gather ideas and innovations in order to tackle the constraints within the existing system, such as: the persistently low rate of herder insurance; the limited number of subscriptions to insurance contracts; difficulties in informing the population how the insurance product works. This competition is part of the long-term work already done in this area, particularly with videos aimed at the pastoral community, picture books, group games, and lotteries, among others.[30]

[30] https://ibliinnovationschallenge.wordpress.com/

4.7 TIER-BASED RISK MANAGEMENT: INDEX-BASED INSURANCE AS AN ELEMENT OF A MUCH LARGER MECHANISM

In most of the systems which have been established (as we have seen in the case of IBLI Mongolia), climate risk is addressed and treated in stages, depending on its severity. Simply put, the principle is that, in the case of a minor crisis, it is the producers who must bear the risk. If a crisis spreads throughout a certain area, for example, at a first level of severity, the insurers will bear the risk and trigger the compensation process for the producers. If it is a situation on a larger scale, the insurers will share the risk with reinsurers. And, in the case of a major crisis (e.g. a major drought in the Sahel), there is no other choice but to involve national governments.

This approach – necessary for the insurance sector, which would be unable to bear the entire risk – has several implications.

Risk management must be part of a public-private partnership, as no insurance system would be able to assume the entirety of the risks associated with agricultural and livestock production. However, in terms of index-based insurance, the expectations created for developing economies have not been met. Most efforts have focused on the design of insurance products, but not enough on the institutional framework, such as public-private partnerships. It needs to be recognized that index-based insurance can only be commercially viable if it is rooted in a broader agricultural and livestock risk management system, including subsidies for the poorest segments of a population in order to turn them into potential customers, as well as finding adequate funding mechanisms to allow governments to manage losses in case of disaster.[31]

The essential role of the state in the management of major crises raises the question of its means of intervention and its speed of action. This question reaches beyond the scope of microinsurance to reach the broader issue of safety nets, including, for example, cash transfers in crisis situations, as well as the support for the strategic destocking of animals during bad years (raising the price of purchase on livestock markets).

It is also necessary to consider the mechanisms offered to national governments (and sub-regional organizations) to insure themselves. However, governments remain reluctant to the idea of using public funds to pay insurance premiums, which in most years, will not provide any benefits. These governments also tend to underestimate the frequency and impact of severe climatic events, which explains why, until now, the demand for this type of insurance has mainly come from multilateral agencies, such as the World Food Program.

The implementation of an insurance mechanism for national governments is also justified from a macroeconomic point of view. Indeed, the protection of livestock capital and, therefore, the support provided to livestock production will have a positive impact on the supply of animal products in both the Sahelian and coastal countries. In fact, protecting the livestock capital will, leaving aside any climate-related considerations, contribute to maintaining a certain degree of stability in the supply of meat. This stability is essential to the functioning of the value chain and to satisfying the growing demand for meat in rural and urban areas. Livestock is also an important source of export revenue for the Sahelian countries. It is essential that the market shares that they currently hold in coastal countries such as Benin and Nigeria are maintained or even expanded, and not gradually replaced by imports from Latin America or Asia.

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[31] **Herbold J.**, 2014, Index insurance for agriculture-separating fact from fiction, Paper presented at the International Microinsurance Conference 2014, Mexico City

The required intervention by the state in force majeure situation will oblige the inclusion of index-based microinsurance as one of the parts of a comprehensive approach to risk management. For example, in Ethiopia, the approach used with agricultural producers (the R4 Rural Resilience Project) since 2009 by OXFAM America, WFP, the Rockefeller Foundation, USAID, Swiss Aid, and Swiss RE as reinsurers combines several levels of intervention:[32]

- An index-based insurance covering climate risk,
- Cash for Work and government safety nets to reduce risk,
- Access to agricultural credit linked to a subscription to a microinsurance contract,
- The creation of savings reserves.

Several tools are currently being designed or tested to facilitate direct insurance with national governments for the management of drought-related disasters. ARC (Insurance Risk Capacity, through ARC Insurance Limited) is an insurance pool providing index coverage to African governments in case of major drought. Created in May 2014 with 4 countries, this type of insurance at the national level is continuing to expand to other countries. The maximum coverage available is 30 million US dollars per country. Payments are triggered by an application (Africa Risk View) which quickly translates satellite data on rainfall into estimated costs. ARC was established as a special agency of the African Union, with the support of the WFP, DFID, Sweden (SIDA), IFAD and the Rockefeller Foundation. ARC is funded by DFID and KFW (Germany). The risks are transferred to international insurance and reinsurers through brokers.[33]

In Ethiopia, an initiative was implemented in 2006[34] through a partnership between the World Food Programme (WFP) and the government. The main objective of this project was insurance against the risk of a national disaster caused by drought on the international markets. The insurance targeted a group of 5 million people in situations of temporary food insecurity and directly affected in case of drought. The Ethiopian Drought Index was created on the basis of historical data provided by the Ethiopian National Meteorology Agency (NMA), associated with a crop water balance of agricultural productions. Rainfall monitoring has been implemented in 26 meteorological stations across the country. The index showed an 80% correlation with the number of food aid beneficiaries from 1994 to 2004, proving that it could be a good indicator of human needs during droughts. Axa Re reinsured the contract, with a premium fixed at 0.93 million USD and a maximum compensation of USD 7.1 million in the event of severe drought. In October 2006, at the end of the coverage period, the Ethiopian Drought Index was well below the trigger level set at USD 55 million, with that year's rainfall having been above normal. No compensation was therefore paid. The coverage was not renewed in 2007 due to a lack of support from donors.[35]

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[32] International Microinsurance Conference 2014, Mexico City, Closing the protection gap through financial inclusion, Index Insurance Solutions for Emerging Consumers, Swiss Re America Holding Corp, Swiss Reinsurance Company.

[33] **DFID, Rockfeller Foundation, AU, WFP**, ARC (African Risk Capacity), Preparatory file.

[34] **Hellmuth M.E., Osgood D.E., Hess U., Moorhead A. and Bhojwani H**. (eds) 2009. *Index insurance and climate risk: Prospects for development and disaster management.* Climate and Society No. 2. International Research Institute for Climate and Society (IRI), Columbia University, New York, USA.

[35] It should be noted that, following this pilot project, WFP and the World Bank developed the LEAP software (Livelihoods Early Assessment and Protection), a piece of software for the preliminary evaluation and protection of livelihoods. Based on the Water Requirement Satisfaction index (WRSI) developed by FAO, this software allows users to quantify and index the risk of drought and excessive rainfall in a specific administrative entity. The software monitors this risk and provides an indication of the disbursements incurred in the larger scale application of the Ethiopian Productive Safety Net Program (PSNP), a governmental program targeting the poorest populations facing food insecurity, no matter the climatic conditions. It is also able to cover areas without any meteorological stations, thus including all of the administrative entities of the countries. LEAP then provides an estimate of the financial scale of intervention necessary in order to safeguard livelihoods in case of climate crisis.

The question now emerging is thus to understand the most appropriate level to insure: is it better to insure producers directly or rather provide insurance through development partners and national governments (IFAD, 2010)? This question can be asked in different ways. Thus, is it pertinent and effective to spend considerable sums for the development of index-based insurance without, in parallel, investing to strengthen successful risk management strategies such as (in a pastoral context), access to water, livestock feed, or securing mobility? Is it better to develop a complex index-based insurance product for herders or to promote the creation of contingency funds on the international market, usable in case of major disaster and quickly convertible into cash transfers to reach those most affected?

4.8 Reinsurance: a pre-condition

Without support and subsidies from international aid, the world's major reinsurance companies would still show little interest in index-based insurance.

And yet, reinsurance is nonetheless a prerequisite for index-based insurance to spread more widely: on 36 index-based insurance programs reviewed by IFAD in 2010, 19 have been reinsured for a total of 2.5 million policies, against a total of only 9,500 policies for non-reinsured products. Clearly, then, reinsurance is necessary to reach a greater number of beneficiaries.

As an alternative to reinsurance, it is estimated that the recent developments in global financial markets have greatly facilitated the use of new financial instruments, such as weather derivatives and crisis bonds, to more widely spread covariant risks. However, the high transaction costs associated with these instruments have contributed to curbing their use in developing countries and in the context of managing agricultural risks. These costs could be reduced if governments contributed to pooling the risk at the national level and to the insurance of a part of this aggregated risk, before transferring it to the global market. The need to transfer risk on this market could be reduced at the source if international development banks or other capital market actors provided precautionary loans to governments, thus creating a pooling system in which the government would have sufficient capital to cover all losses incurred during a bad year. While such an arrangement would raise questions regarding the exclusion of private reinsurers, it could prove invaluable in the early stages of the launch of an insurance program, until adequate reserves are constituted. (IFAD, 2010).

4.9 Which risk to insure?

The choice of risk to insure in terms of index-based insurance is fundamental, because it determines both the nature of the index to build as well as the exact definition of the coverage to be provided. As a general rule, index-based insurance is centered on a specific risk, and this can be a limiting factor. For example, livestock losses due to illness are not covered by an index-based insurance which focuses on drought.

Risk analysis should allow for the development of a more precise typology of insurable agricultural risks and should clearly define the causes of losses according to: risk; type of cash crop; or types of livestock. However, an analysis of agricultural risks faces several difficulties. Systems generating statistics do not include data essential to agricultural insurance (that is to say, losses per insurable risks) and focus instead on area and yields data (for the most important cash crops). Detailed field surveys, which may have to be conducted by government agencies or by interested institutions, are indispensable in order to gather the data necessary for this.

Moreover, the risk analysis model needs to generate a ranking of production systems, as well as a proper identification, mapping and modelling of insurable risks (important for the selection of insurance cover), the causes and the amounts of losses suffered (disasters), a

system of evaluation and appropriate pricing, and an assessment of the probable maximum loss (PML). All of these elements are key to the choice of a reinsurance plan.[36]

For most people, the main risk to be insured in the Sahel, both for agricultural and animal productions, is invariably drought, which is seen as the source of all problems. However, and in contrast to this mainstream opinion, the conclusion of the analysis undertaken as part of this study suggests that this assumption needs to be reviewed in depth.

In terms of agricultural risks, a study conducted in the Senegal River valley on rice, onions, tomatoes and sweet potatoes production clearly showed a multiplicity of risks facing producers, whose impact could be significant on crop yields:

- overall climatic factors: unseasonable rains, floods, early winter rains, rainfall deficits,
- infrastructure: reduction in water flows in irrigation networks, natural water reservoirs and the Senegal River, load-shedding on the electricity grid, and outages of motor-driven pumps,
- parasites and pests: rice mites, white flies and other tomato diseases, onion thrips, sweet potato nematodes, avian swarms, locust, rodents or swarms of wild duck,
- man: wandering animals, fires, salinization of certain zones, inputs,
- marketing: slump in prices and problems of access to market, risks in the transport and removal of crops (Ndiaye, 2011).

Ultimately, it is clear that the dryness factor (rainfall deficit) is only one of the risk factors, and that excess rainfall, or rainfall poorly distributed in time can have equally disastrous consequences on crops. Furthermore, the study reveals the importance of also putting forward non climate risks, whether they are linked to infrastructure, parasitic diseases, pests or market conditions. Therefore, much more than simply the drought factor, it is ultimately the combination of all these risks, and their relative weight during the year, that will determine the performance level of production.

The same observations can equally well be made as regards livestock and livestock production with, in addition, the distribution of risk in space because of the mobility of herders and the necessity to assess the widespread and often prolonged effects of a crisis on the dynamics of a herd. In order to illustrate these challenges, a fictional portrait of an agro-pastoralist – Moussa – has been developed, which analyses a variety of situations encountered in the Sahel, as he embarks on an annual cross-border southern transhumance to a coastal country (see Annex). Based on a set of data gathered over the past thirty years by researchers, this portrait remains a deliberately simplified version of a more complex reality.

Through this portrait, several important observations can be made:

- Among the many risks faced by herders, few are ultimately attributable to drought as such. This fact affects both animals that remain behind at the home base during the dry season (sheep) and those that go on transhumance during the same period (cattle). If a drought occurs, unlike a field of crops, which cannot move, a herd always retains the option of leaving the affected area for a certain period of time.
- While the climatic factor is not negligible, it can encompass other aspects in addition to drought (e.g. floods in Mounouk Park or river overflowing its banks in northern Gani, torrential rain during the cold dry season in the pastoral zone where Moussa lives), all of

[36] **Ndiaye A.**, N., 2011, *Problématique de la couverture du risque agricole en Afrique, communication présentée dans le cadre de la 35ème Assemblée Générale Annuelle de la* FANAF, Dakar, February 23rd, 2011.

which are risks that are not covered by an index-based insurance focused specifically on drought. In addition, excess rains can have devastating effects on animals. A very rainy year, for example, often results in a rise of parasitism, resulting in livestock losses.

- Unlike climate risks linked to agriculture, risks linked with pastoralism occur in different places which are often very distant from each other, over areas measuring several hundred kilometers.[37]
- Because of the close links between agricultural and pastoral zones, and the interdependency links which result from them (including exchanges of manure for agricultural residues), herders also bear a significant part of the agricultural risks which would normally fall upon other actors. If a farmer's crops are harmed with subsequent reductions in yield (through climate factors, crop diseases or other), then this has a significant negative impact on the nutritional cycle of the herd.

The same observations apply to Samba, Moussa's son, who regularly treks livestock on-the-hoof to the southern markets for a trader. For all practical purposes, the sector's operators experience the same problems as the transhumants and run the same risks. These include, for example, the poor condition of the loading ramp at Kouka, which will partly determine the success or failure of the transporting operations for the live animals to their end-station, the Laguma market. Similarly, the dilapidated state of some trucks will be a source of accidents during the transportation of fattened cattle.

Finally, most factors that affect a household's economy are linked to factors which are either **anthropic** (e.g. agricultural land clearing for agriculture encroaching on livestock corridors, land clearing of false fields in the bush to trap herders into making payments for crop damage, cattle rustling), **institutional** (crossing national borders, unfair taxes imposed by municipalities on transhumants, unilateral decision by the government of Manga to change the official date of departure of Gani's transhumants), or **zoosanitary** (foot-and-mouth disease). The risks can also be linked to **infrastructure** (borehole breakdowns), the local **ecology** (herbaceous species causing diarrhea in young animals), and **accidents** (injuries, bush fires).

The impact of each of these risks on the dynamics of livestock capital is complex and their effects are often delayed. For example, foot-and-mouth disease problems will reverberate for many years on a herd's demography. Similarly, the fact of not having access to agricultural residues along the river during the cold dry season will result, over the following months or years, in a slowdown in a herd's growth due to the effects of malnutrition on livestock reproduction.

This also applies to a drought. Unlike a context such as that in Mongolia where a dzud causes livestock deaths among all herds that are unable to seek refuge elsewhere, a drought in the Sahel can be approached mechanistically, based on an index establishing an immediate correlation between rainfall and fodder deficit with a heightened mortality rate per animal species. Post-drought studies have unequivocally shown that animal production systems are highly heterogeneous and that the situation of herds varies considerably from one family to another. In addition, the mobility factor is crucial to mitigate the effects of drought. It thus plays the role, more of a trigger for a deeper crisis, further illuminating the weaknesses of the economic environment and the legal or institutional framework in which risk management strategies work increasingly less well.

[37] While there are small and medium-range transhumance migrations among the different livestock systems in the Sahel, almost all countries have very long-range transhumance systems. Thus, in Chad, the north-south transhumance between the Sahelian and Sudanian areas is made along a transect of nearly 1,000 km. In Senegal, the transhumance of small ruminants in the Saloum takes place over several hundred kilometres. In Niger, the eastern WoDaaBe herders often transhume across several countries (Niger-Nigeria-Cameroon, Chad), with Lake Chad operating as a hub.

These conclusions require a broader vision of pastoral risks and, consequently, call into question the very purpose and utility of an index-based microinsurance. If this type of insurance must imperatively be based on a climatic index relating drought to mortality rates, one must question its relevance. Such insurance, in fact, ignores the multitude of risks which are not related to a rainfall deficit. In a production system such as the one described throughout the portrait, it becomes essential to consider what is really insurable, not only from the point of view of the state, but also from the point of view of private operators, insurers, and reinsurers. Given the multitude of risks incurred by the producer, it is also necessary to question the utility of systematically ignoring traditional insurance products which cover several risks, simply based on the idea that they would be inadequate and unable to cover large populations. Indeed, from this point of view, the low penetration rate of index-based insurance for livestock does not really argue in its favour. In addition, for traditional insurance, the extent to which insurers might be willing to cover endemic diseases, such as foot-and-mouth diseases, as well as constraints related to sanitary controls, still remain to be evaluated.

4.10 What is the impact of non-climate-related risks? - an ongoing AFL survey.

A risk analysis was implemented as a significant part of a 5-country survey carried out at the end of 2015 throughout West Africa, (Niger, Burkina Faso, Mauritania, Mali, Senegal) among a large sample of transhumant families (386). This survey included a specific focus on non-climate-related risks relating to pastoral and agro-pastoral resilience. Through a co-financing mechanism, the AFL-PRREF[38] and the DFID-funded AFL-BRACED programme[39] carried out a series of strategic reflections on the potential of developing insurance products linked to and addressing the risks faced by pastoral and agropastoral households in the region.

In line with the results of the preliminary study, the 5-country survey raised the question of non-climate-related risks. As the BRACED programme is based on the principle that climate-related risks associated with droughts are best addressed through mobility as the optimum strategy to manage and reduce herd mortality, the above-mentioned survey also focused on and specifically included non-climate-related risks.

Nevertheless, the survey also included two specific climate-related risks in the questionnaire. Rather than being linked to rainfall deficits, the focus here was on the other extreme (excess rainfall), looking at risks too often under-estimated yet with a potential impact on herds which should not be overlooked:

a. Floods caused by excessive rainfall: an occurrence as likely to arrive in the Sahel as also in the coastal countries where many herders go on transhumance. Excess rain can cause erosion, and result in flooding pastures and sweeping away young animals. Such rains are equally likely to result in a rapid rise in water levels in rivers and watercourses that need crossing, bringing with it the danger of livestock loss through drowning.
b. Off-season rains: these are rains which arrive outside the normal rainy season, that is to say, during the dry season. Dry grass becomes wet, lies flat and rots. Livestock will not feed on this. This is a loss of pasture which reduces livestock fodder intake and can contribute to livestock losses. Off-season rains can also take the form of violent downpours which, when they happen during the dry cold season, can result in intense bouts of pneumonia, affecting especially the small ruminants.

[38] PRREF - Projet de Renforcement de la Résilience de l'Économie Familiale grâce à la Productivité de l'Élevage dans le Sud et l'Est de la Mauritanie, financed by the European Union.
[39] Building Resilience & Adaptation to Climate Extremes & Disasters Programme AFL-BRACED

In total, 11 risks were pre-identified, for the most part corresponding with the types of risks which could potentially be covered as a standard insurance product:

- Injuries
- Predators
- Bush fires
- Flooding
- Broken boreholes and broken motor pumps
- Snake bites
- Road accidents
- Off-season rains
- Livestock theft
- Drowning

And, added to this list, the risks associated with livestock diseases.

For each risk encountered during the transhumance of 2014/2015, the critical information gathered related to the total number of animals lost whether through livestock mortality, slaughtered for immediate consumption or as emergency sales to butchers. Even if emergency sales are not a direct loss, as such, these sales are still considered to be a significant reduction in income, as the animal is sold very cheaply

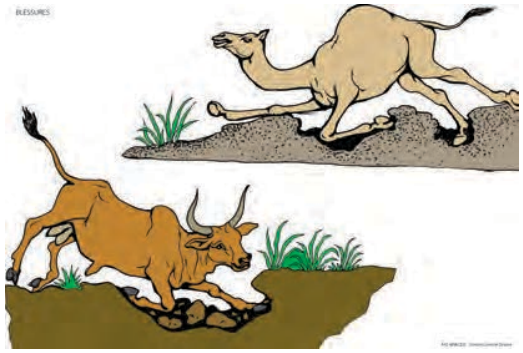
It was also important to identify the event's frequency. For example, an attempted theft of livestock can be foiled by the herder (the risk materialized) but the thieves were prevented from taking the animals (the risk was not translated into a loss).

In order to facilitate the analysis, a series of images was developed as a pictorial support which allowed the interviewer and the household to better visualize and sort the identified risks. Thus, when coming to the step of identifying the situations experienced by the herder, it sufficed to put to the side those risks that had not been encountered during the transhumance. This visual support is shown on the next page.

The final results of the survey will be available in the Autumn of 2016. Nevertheless, the preliminary trends, as data was processed, have tended to confirm that it is not predominantly climatic risks but all the other identified risks that have the most significant impacts on the family herd.

Visual presentation of the risks faced by the sampled households

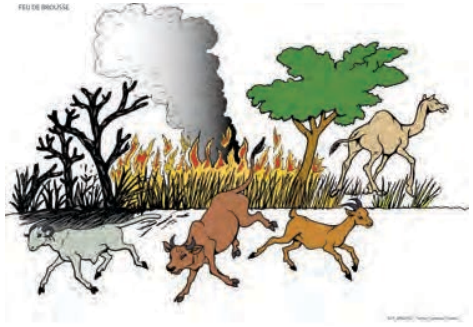
Road accidents



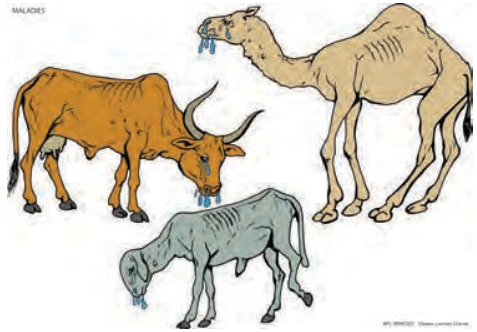
Injuries

Predators (jackals, hyenas)

Excessive rain (flooding)



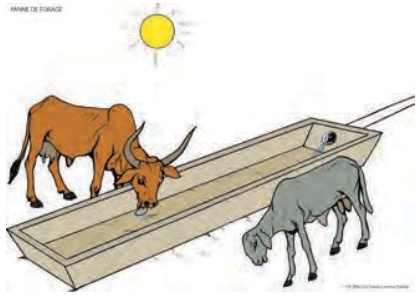
Bush fires



Illness

Livestock theft

Drowning



Broken boreholes (pumps)

Off-season rains

Snake bites

Index-based insurance systems usually establish a gradation of the risks of drought and compensation thresholds which are triggered in the case of situations considered relatively serious. For the remaining lower-impact and less serious rainfall deficits (and consequently, also the fodder deficits) the impacts must be borne by the herders themselves. Another question thus needs to be asked:

4.11 Is drought really THE risk to cover?

Until now, the sustainability of most index-based insurance systems (both at the agricultural and pastoral level) has been based on a hierarchy of climate risks and the establishment of trigger thresholds which must allow time for insurers to build up reserves, while ensuring a transfer of risk, if necessary, to reinsurers and the state.

From there, and to stay in simple terms, drought remains an insurable risk, but only when it is "relatively serious," affects many people and does not happen too often. The current debate on the limited control over basis risk in index-based insurance brings out a basic principle to limit this risk: the insured climatic event must be infrequent.

It is thus important to look deeper into this issue. The situations whose gravity automatically trigger compensation for a large number of producers need to be infrequent in order to allow insurers to accumulate sufficient reserves to be able to make the payments. Otherwise, insurance becomes unprofitable as a business operation. This was a major problem in Mongolia. In June 2010, a total of four complete insurance cycles had been completed. The first year had been relatively good. However, the following years were marked by high mortality rates all of which triggered a compensation process, thus becoming an untenable situation for insurers.

In fact, in terms of index-based insurance, IFAD (2010) points out that the actual premium to be paid ultimately depends on the cost of the pure risk premium. In other words, if the probability that the insured event occurs is very high, the pure cost associated with the risk can become prohibitive. As such, insuring a climate event that occurs with a higher frequency than once every 7 years can become too costly for producers, with the risk eventually becoming uninsurable for insurers.

A study in Niger, conducted in 2013 with the participation of the World Bank,[40] showed that the gradation of drought risk (in the southern part of the country) amounts to:

- Every 3 to 10 years for minor drought conditions,
- Every 6 to 10 years for moderate drought conditions,
- Every 21 to 25 years for serious nationwide droughts,
- Every 26 to 30 years for droughts on a sub-regional scale.

Comparing this to the risk severity scales used for Mongolia and Kenya, it is clear that droughts of national and regional significance necessarily require a joint intervention of national governments and international financing mechanisms in order for catastrophes to be tackled successfully.

Otherwise, localized minor droughts usually fall under the responsibility of herders who can, on these occasions, activate their "social safety nets." All that thus remains for index-based insurance would be to insure moderate drought conditions, occurring every 6 to 10 years.

[40] **RSMI-India and World Bank Group**, 2013, *Implications du secteur privé pour renforcer la résilience de l'agriculture du Niger aux changements climatiques: évaluation du marché de l'assurance agricole.*

However, the reality is often more complex. Niger is a case in point, where annual assessments of fodder deficits per region are available. The results of the assessments carried out between 2000 and 2013 clearly show the regular recurrence of drought in some areas, as well as the fact that such droughts can sometimes become chronic. (see below):

REGIONAL DISTRICTS	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Years of deficits
Agadez	152.650	129.948	34.684	128.971	-98.890	125.753	94.824	430.682	-222.709	-212.533	444.890	-263.222	1.294.530	-29.935	5
Diffa	-1.533.583	-1.829.517	-2.078.035	-1.404.197	-2.380.057	-744.691	-1.508.316	305.602	-915.870	-2.251.421	284.294	-1.069.719	856.184	-1.121.035	11
Dosso	-95.952	390.718	-151.637	-71.509	-414.534	404.540	1.354.021	-75.563	-479.281	-1.159.377	-297.334	-330.648	-513.784	-609.119	11
Maradi	228.511	27.680	92.821	89.842	-261.705	909.901	313.487	-526.379	-452.882	-2.710.110	1.058.784	-1.086.105	-359.128	-1.186.167	7
Tahoua	191.880	742.167	-35.442	677.454	-661.102	-275.799	753.836	741.871	-1.335.458	-2.393.341	1.467.094	-2.290.288	829.927	-1.316.648	7
Tillaberi	-784.212	1.604.928	380.507	793.420	-611.884	527.140	783.124	377.131	-633.442	-3.629.642	-2.099.515	-2.769.227	-1.132.939	-2.099.619	8
Zinder	369.395	253.739	425.477	1.404.197	-137.708	978.718	1.064.526	-147.828	-1.236.891	-3.670.019	507.743	-2.309.329	883.002	-202.681	6
Niamey	-51.230	-55.940	-56.340	-59.878	-52.965	-37.969	-66.708	-99.144	-76.609	-115.566	-120.030	-103.870	-89.904	-145.172	14
NIGER	-1.827.841	1.319.663	-1.387.964	1.412.600	-4.642.219	1.887.591	2.788.794	1.006.373	-5.353.140	-16.137.329	1.245.926	-10.222.408	1.767.888	-6.710.376	7

Source: Compilation provided by the Ministry of Animal Resources. Biomass volume expressed in tons of dry matter. Negative values for years of fodder deficits shown in colour.

Over a period of 14 consecutive years, it is apparent that all regions of the country have experienced at least five years of drought. Some of them have even been in a chronic deficit situation (such as in the Diffa Region, with annual deficits over the last 11 years). These dry spells can be localized to one or more regions, and may sometimes be national in scope, as in 2004, 2008, 2009, 2011, and 2013.

Ultimately, a situation of pastoral drought occurs every year or, at best, once every two to three years. As this constitutes a genuine chronic risk, this begs the question of whether it would be genuinely insurable through an index insurance whose development, implementation and monitoring costs would remain very high.

This poses fundamental questions on two levels:

- More significant than major drought episodes, what has really eroded the viability of pastoral systems in the Sahel over the past 50 years has precisely been the recurrence, year after year, of partial rainfall deficits, resulting in localized drought situations whose impact on herders can be felt as harshly as that of major droughts, but whose limited scope means that they will always be below the trigger level detected by whichever climate index is chosen.
- At the same time, the cumulative effect of these "micro-droughts, on the herd economy and, consequently, on the vulnerability of herders is also rooted in a wide range of non-climate-related risks. If these were better managed, the resilience of herders to climatic events would certainly be strengthened, even if they are not covered by an index-based insurance.

The wisdom of bearing the high costs of developing, explaining, promoting and monitoring a livestock drought insurance needs to be seriously considered, when the majority of situations encountered by herders will not be covered by the insurance. In addition, in case of a major drought (national or sub-regional), the index will in any case lose its significance given the obvious nature of the signals and the clear evidence of the existence of a major crisis. In addition, in the context of the Sahel, the development of an index tied to projected mortality rates constitutes a work of considerable scope, given the virtual absence of reliable data and the diversity of the micro-local situations encountered.

Moreover, unlike farmers, who are quickly able to restore their agricultural production at the end of a crisis, herders incur losses which, while not necessarily resulting in direct livestock mortality, will result in a decrease in the growth rate and productivity of their herds over several years. Such losses are difficult to assess at the individual level and will not, in any case, be covered by index-based insurance.

4.12 A PRESSING NEED FOR INSURANCE PRODUCTS BENEFITING LIVESTOCK TRADERS AND OTHER STAKEHOLDERS WITHIN THE VALUE CHAIN

The portrait of the fictional agro-pastoralist on the annual transhumance to the south, shown in the annex, highlights the immense void in terms of the provision of insurance products for traders, transporters and other actors involved in the livestock value chain. Senegal's CNAAS offers insurance for butchers at the time of slaughtering, but this insurance product only covers a single link in the value chain, at the end of the process. However, both for trekking on the hoof as well as for the vehicular transport of livestock, all operators in the value chain criticize the difficulty of finding adequate insurance coverage. And yet, they are potentially prime customers for livestock insurance due to the large numbers transported, within a relatively short space of time.

Similarly, there are only a few examples of insurance products designed for women which take into account their specific needs. And yet, they form a distinct client segment. They are often involved in fattening livestock and tend to stay close to the animals, especially young animals, in the camps. In many transhumant systems, the women stay behind and become the guarantors for the animals that remain at the home-base. To this needs to be added the ability of the women to save money. In Kenya, for example, the women have often been the ones to provide their husbands with the funds required to pay for the insurance contracts.

5 CONCLUDING REMARKS

Livestock insurance remains a product largely inspired by crop insurance. Using data from similar sources (rainfall and NDVI[41] data), the index correlates climate conditions with the mortality rates in family herds, rather than with crop yields, as is the case with agricultural insurance relating to harvest losses. However, there are many differences between the agricultural and pastoral systems in the Sahel that argues against a somewhat mechanical application of agricultural insurance to pastoral systems.

Unlike a farmer who can reconstitute his production system as a result of the next good rainy season, the impact of a rainfall deficit on a herder's capital will continue for several years, and with delayed effects. Thus, the inability of animals to regain their weight during the rainy season due to nutritional deficiencies can result in a slowdown of adult female fertility and, in this way, impact negatively on herd growth.

The risks incurred by herders are many and, of these, droughts – often integrated as an essential element of the management strategies – are not necessarily the most important. These risks are also dispersed, covering a wide area, including over several countries in the case of cross-border transhumance. Moreover, the overlapping between agricultural and pastoral livelihood systems means that a pastoral crisis, from the point of view of a herder, may just as well occur as a result of crop losses (resulting from localized drought or, conversely, floods) in a zone far to the south with, as a consequence, that he would be unable to enter into manure contracts with crop farmers which would allow him access to agricultural by-products.

[41] NDVI - Normalized Differential Vegetation Index

Basis risk remains difficult to control. The situations on the ground are often volatile, livestock systems are diverse (between northern pastoralists and southern agropastoralists) and, within the same micro-zone, the specific situations of households are highly differentiated. The economic and social mobility of herders between wealth and poverty is also a major constraint. To overcome it, the example of Kenya shows that an index-based insurance should have a clear upstream picture of the vulnerability levels among its target groups, in order to ensure a downstream monitoring of these groups to avoid leaving the most vulnerable to languish below a critical poverty threshold as a result. This implies the need for (significant investments which, consequently, also calls into question the often-claimed advantage of index-based insurance as a cheap product capable of reaching the masses.

To date, the experience derived from the index-based insurance products developed in the context of extensive livestock systems (including Mongolia and Kenya), instead of encouraging the direct application of these products in the Sahelian context, rather call for extreme caution. Instead, a number of substantive issues, which are often relegated to the background by the considerable investment entailed by the creation of climate indices, need to be considered. The mixed response of herders to the index-based insurance products implemented so far in Northern Kenya would suggest that the product may need to be further developed and refined. In the context of the Sahel, it needs to be questioned whether this is really the right product to offer, at the expense of more traditional forms of insurance that would have the advantage of insuring several types of risks, and whose adaptation to the specific requirements of the pastoral environment have been insufficiently explored. This is why the current experiments, led by the CNAAS in Senegal, are important to follow.

Moreover, it is not certain that the conditions are currently in place to enable an informed debate which can bring together the key stakeholders, including the potential beneficiaries, both the herders themselves as well as the operators in the livestock marketing value chain. Among the key lessons learned, the designers of the IBLI in Mongolia stressed that, in this country of herders, both the national government and the provincial authorities had an intimate knowledge of the situation of livestock in the country, as well as an in-depth understanding of the mobility systems and the strategies used by the herders. As such, even if it was initially based on the concept of the "supply" of an insurance product, the product which was put on the market was based on a clear vision of the herders' livelihood systems, the constraints they face, and the various risks which they have to bear.

As regards the debate on index-based livestock insurance in the Sahel, it is unclear whether those currently involved in developing a similar product for the Sahel, have a comparable understanding of the Sahelian livestock systems for which the IBLI product is being designed. The objective of this report, which draws on the authors' long-term experience with Sahelian livestock systems, is to contribute to this debate.

ANNEX

The Concept of Risk Associated with Pastoral and Agropastoral Herding in the Sahel:

(A case study of an agropastoralist on transhumance)

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1. REVIEW OF A FEW BASIC NOTIONS

1.1 Basic concepts on pastoral production in the Sahel

a) Ranges

In the Sahelian pastoral zones, natural pastures are mainly composed of annual grasses whose rapid growth lasts from one to three months, during the short rainy season.[42] The arboreal vegetation (trees, shrubs) is sparse and is often limited to depressions receiving runoff.

The nutritional value of the annual grasses is high during the rainy season. They die and dry out after fruiting to become a stock of standing biomass which slowly diminishes until the return of the next rainy season. As the dry season progresses (from November to July), its protein, vitamin and mineral content is reduced. This is the period during which the animals gradually lose weight. As such, the green foliage of the trees and shrubs is vital for the livestock in search of nutritional compensation. During the dry season, many herders also trek their animals to the agricultural zones where they can consume agricultural residues.

The biomass standing at the end of the rainy season must thus be sufficient to maintain the animals during the dry season. When pastures are fully grazed before the end of the dry season, livestock undergo nutritional stress and herders are forced to go elsewhere. However, if the pastures are under-consumed, the vegetation suffers from biomass accumulation and, after a few years, loses productivity. Thus, the problems related to grazing management during the dry season are mainly due to the rate of biomass consumption. Overgrazing can, however, affect the tree and shrub layer, since the animals depend on the green foliage to compensate for the low nutritional value of the fodder.

The volume of seed production ensured by the annual grasses is usually high, since it can reach 60,000 seeds per square meter for some species (such as the *Panicum laetum*), and their life cycle can last several years. The composition of the flora of the herbaceous layer can thus change considerably from one year to another, depending on rainfall. Those grasses well adapted to drought conditions can grow rapidly, while others remain dormant. The monitoring of rangelands over several years shows that the Sahelian pastures are actually remarkably resilient and able to recover quickly from a climate shock.

The risks of rangeland degradation are mainly present in the rainy season. Concentrations of animals can cause an excessive trampling of the grass, especially at the beginning of the growing season, when the first localized rainfalls attract a large number of animals in search of fresh grass. These risks are, however, limited to a short period, as the herds disperse rapidly once the rainy season has well and truly begun. Another critical moment occurs during the flowering period, at which point the seed stocks held in the soil must be large enough to ensure the germination of the plants for the coming year. These seed stocks are important. In addition, many annual species have developed their own system of protection against overgrazing by producing thorny fruits that repel animals.

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[42] Perennial grasses (species that do not die off in the dry season but become dormant) are confined to wetland habitats, such as low lying areas (depressions) and valleys.

Contrary to popular opinion, which often sees livestock mobility as an outdated and unproductive practice, compared to sedentary and intensive systems, technical and scientific studies conducted over the last 20 years have shown that this mobility is, on the contrary, a fundamental management strategy for resources that are dispersed, unpredictable and highly variable, depending on the year.

Indeed, mobility makes it possible to make constant adjustments between stocking rates and carrying capacity, as well as to ensure optimal vegetation dynamics. The livestock-vegetation interaction is a crucial element for vegetation growth. Animal skins serve to scatter seeds, as these cling to hairs, and livestock, by feeding on fruits, contributes to the regeneration of the trees. In addition, the cattle hooves bury the seeds, and this trampling in turns facilitates the infiltration of water and seed germination. The fact that animals consume standing grasses during the dry season also prevents the accumulation of biomass, which can harm the regrowth of fresh grass. Indeed, enclosure experiments (with complete protection and exclusion of livestock) have shown the medium-term impoverishment of ecosystems when animals are not quickly reintroduced in the protected area to eliminate biomass accumulation and promote arboreal regeneration. Ultimately, rainfall and aridity exert a more decisive effect on the composition and productivity of pastures than the number of animals stocking rates.

The risk of overgrazing and rangeland degradation predominantly occurs when livestock mobility is limited and the animals maintain high intensity pasture activities for continuous periods. Research conducted on north-south transects in the Sahel confirm that this type of situation occurs especially in densely cultivated areas, where local herds are confined in pastoral enclaves during the rainy season.

b) Water points

During the rainy season, natural depressions are filled by rainfall. These natural ponds then give livestock easy access to surface water and allow the herds to move about freely. With the approach of the dry season, however, the ponds dry up, forcing herders to move closer to deep water sources, such as traditional wells, modern cemented wells, and high-yielding boreholes equipped with pumping stations. The oscillating movement of livestock, which alternates between water points as their destination and departure points, define the limits of the available grazing area. This area usually has a radius of between 15 to 20 kilometers and varies among species (camels and cattle can travel greater distances than sheep and goats) and seasons (the animals need to drink less during a colder dry season).

During the dry season, water is thus the key that opens the door to pastures. Given that mobility remains essential during this season, access to water must remain open to multiple users. Should these water sources become the property of private individuals, livestock mobility would become impossible, while the communities living in the areas with pasture deficits would be condemned to misery. Public access to water points may, however, lead to high animal concentrations and quickly cause risks of overgrazing and reductions in fodder resources before the return of the rains.

The controlled access to water (instead of exclusive rights or, conversely, public access) has through the ages allowed herders to use water as a management tool for fodder resources, as shown by the example of traditional wells in eastern Niger. These hand-built, small-diameter wells have a short lifespan (from 1 to 3 years). With a depth of 15 to 30 meters, they have an average yield of around 1 cubic meter per 10 hours, which allows them to provide sufficient water for a maximum of 300 cattle per day. By comparison, a cemented well, with a yield of 5 cubic meters per hour over 15 hours, can sustain 3,000 cattle per day, and a borehole, several thousand.

The communities who dig the wells enjoy priority water access rights. They allow access to their wells for passing herders after negotiating the length of their stay, the location of their campsite and the time at which they will use their well during the day. The well is thus a control tool for livestock access to the rangeland and for the management of fodder stocks up to the end of the dry season. Negotiations can rely upon various forms of compensation: money (to finance the construction of a new well); tea and sugar; small ruminants; loan of a breeding cow (in certain cases). Passing herders may also offer resident herders reciprocal access to their wells in the future. Through negotiation and reciprocity, traditional wells play a central role in the development of the social capital of communities. The controlled access to the water points gives communities the possibility of having a "home base". Social networks and agreements based on reciprocity allow them to negotiate access to a wide range of resources and preserve their mobility over time.

Over the past 60 years, agreements based on reciprocity have nonetheless been seriously affected by the implementation of modern open access infrastructure. In the 1950s, the discussions focused primarily on the technical aspects, such as the balance between the water point yield, stocking rates and carrying capacity. The risk of a rapid reduction of pastures was analysed primarily with regards to boreholes, whose high yield allows a large number of animals to be watered. In order to avoid this risk, laws were adopted in several countries, particularly in Senegal and Niger, to control stocking rates. The laws have, however, proved difficult to implement and were quickly abandoned. Modern wells and boreholes have thus become open to all by force of circumstance. During the 70s and until the late 80s, large pastoral water programs have continued to be implemented in many pastoral zones of the Sahel.

The introduction of open access water infrastructure has greatly affected the management of pastoral resources. The rangelands on which residents have priority water access (within the framework of the control of access to traditional wells) are now accessible to all, since passing herders are able to water their cattle at public water points. These public water points, particularly boreholes, have attracted large numbers of herds in some areas. Access to water has been correlated with the use of force, at the expense of negotiation and reciprocity. The creation of management committees for pastoral wells and boreholes, created in the '90s, did not provide a lasting solution to the problem. In Niger, for example, these committees were ineffective and only possessed limited powers mostly related to the financial and maintenance aspects of wells, rather than to the control over stocking rates and fodder consumption patterns in the affected areas.

1.2 Pastoral drought

Over the past century, the Sahel has been hit by severe droughts (1914, 1931, 1942, 1973, 1984, 1992). In addition, localized droughts are a recurring phenomenon. In 2004, 2008 and 2009, important rainfall deficits affected Niger. In 2001, 2005, 2006 and 2011, northern Senegal suffered from an acute fodder deficit, forcing a large-scale transhumance and long-term migration. In Mali, the Gao region experienced similar periods of crises in 2009, 2010 and 2013.

Droughts occur when people and animals are already at their lowest point: the end of the dry season. Rainfall deficits quickly translate into shortages of fodder resources and surface water, with immediate effects on the animals, especially the most vulnerable species such as sheep and cattle. Poor pasture conditions have an effect on the survival rate of young animals, with calving usually taking place at the end of the dry season. Milk production decreases and lactation eventually stops. The decline in fertility rates has implications for the number of calves the following year. The weight of the animals decreases and the return to

their maximum weight becomes impossible, while access to veterinary products or supplements rich in protein such as cottonseed cakes remains limited. The animals quickly lose their market value. Mortality rates increase, especially in young animals, and destocking (with as consequence the sale of animals at very low prices) intensifies, resulting in heavy losses (up to 60%), both for households and national economies. The loss of animals is thus attributable both to their sale on the markets as well as to direct deaths. Several post-drought studies after 1984 have shown that sales sometimes account for over 50% of total household losses. For several years after a drought, livestock markets are characterized by shortages of large livestock (cattle, camels), whose high price slows down the reconstruction of herds among herders.

The preservation of the herd, and in particular of the breeding nucleus, becomes paramount. Pastoral mobility intensifies, often in a southerly direction, towards refuge areas. To spread risk, families separate and herds are divided. Access to cross-border corridors becomes even more vital. Household dependency on cereals grows rapidly. Livestock sales increase, while grain prices rise and the terms of trade between livestock and cereals eventually collapses, forcing herders to start to draw on breeding females, which jeopardizes future herd reconstruction.

Given the relatively low natural growth rates for large animals (approximately 2.7 to 3% for cattle on a continuous 20-year timeline), the theoretical period of time necessary for the reconstruction of a herd is relatively high, and is in direct correlation with the share of the herd culled during the crisis. Growth models developed by the ILRI (International Livestock Research Institute, Nairobi and Addis Ababa) have shown that beyond a recorded loss of over 60%, recovery can take up to 30 years. To accelerate this process, herders use a complex set of strategies: using small ruminants that reproduce more quickly; receiving loans of animals; the migration of family labour; and, in some cases, agriculture. Conversely, over time, farming communities have responded to drought by increasingly diversifying in agropastoral production. However, animal mobility remains crucial even for intensive agricultural systems, such as the cotton growing areas of southern Mali.

Since the 1970s, the impact of drought has proven to be cumulative and has most severely affected vulnerable households: changes in livestock ownership patterns; social stratification; extreme poverty. However, mobility strategies during a drought often determine the size and composition of the remaining herd, as well as the speed of recovery of the household economy. Post-drought studies have unequivocally demonstrated that the cross-border mobility of livestock remains the cornerstone for pastoralists and agropastoralists to cope with climate extremes and variability. However, despite the ECOWAS' regional integration policies on free cross-border movement, transhumance is still subject to various restrictions.

The fiscal policies of decentralized authorities are often detrimental to mobile pastoralists. Livestock corridors are regularly obstructed by areas under cultivation encroaching into the corridors as well as suffering from a lack of infrastructure (water points, rest area). They are also poorly served (access to livestock feed or veterinary products). Market volatility, increasingly restricted access to pastures and sometimes unfavourable pastoral laws have also contributed to the erosion of drought adaptation strategies.

2. THE NOTION OF RISK SEEN THROUGH THE PORTRAIT OF AN AGROPASTORALIST.

Moussa Amadou is an agropastoralist living in northern Gani, in the pastoral zone, in a place called Chétimari, not far from a line of villages to the north, located along the banks of the river, where farmers grow sorghum over an extensive area.

The map of the zone on which the fictional portrait is based is shown on the next page.

With his family, Moussa has a herd of cattle and sheep. He has 25 cattle and some 30 sheep. During the rainy season, he grows some millet and sorghum, but the bulk of his food supply and income is derived from his livestock.

The rainy season is the only time of the year when the entire herd is there, in the Chétimari area. However, rainfall is very uncertain and it never rains everywhere in the same way. Sometimes, it rains heavily in Chétimari but there are no pastures around the nearby borehole in the Bosso area, only 20 kilometers away. During the rainy season, herders are thus forced to move a lot and be very mobile, in order to follow the rains and the pastures. During the years where there is a general drought in northern Gani, he has no choice but to leave. The majority of herders leave to go south and, increasingly, they take refuge in Manga where the grazing situation is always better. However, there, conflicts are frequent and sometimes deadly, and the government does not like transhumants coming from Gani. Transhumants have no protection there.

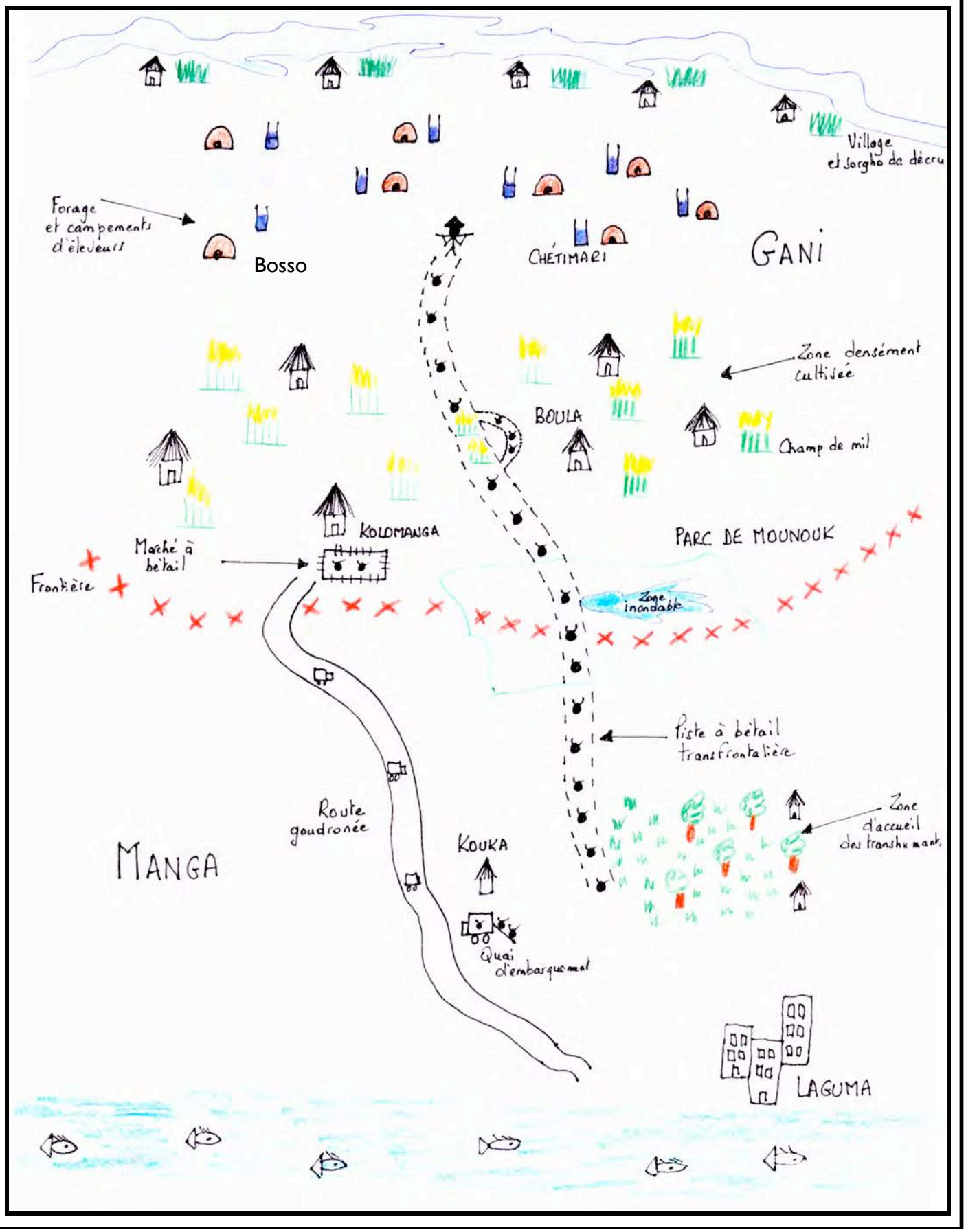
Moussa's transhumance with the cattle in the dry season

During the dry season, Moussa's herd is divided into two: cattle on the one hand and sheep on the other.

During the cold dry season, from November to January, Moussa leaves with his cattle to the river where, in exchange for manure, he can graze his animals on the harvested sorghum fields. However, two years ago, the fields suffered a disease and the crops did not grow properly. That year, when Moussa returned with his cattle to Chétimari, they were in poor condition and had lost a lot of weight because of the lack of crop residues. Another problem lies in the fact that the flooding of the river can be capricious. Some years, the riverbed overflows so much that there are floods and there is no possibility to plant sorghum.

During the hot dry season, Moussa heads to Manga on transhumance with his cattle. However, the herd that he leads is usually larger. Indeed, Moussa takes with him animals belonging to other herders whose herds have become too small to justify being taken on transhumance by themselves. In addition, for many years, he has brought with him a few cattle belonging to farmers from the area along the river, whose fields he manures in exchange for sorghum stalks left over after the harvest. Ultimately, he is responsible for the animals of at least 4 or 5 different families. In total, Moussa often goes on transhumance with some 40 to 50 cattle. He does not like to go beyond this number, as this would require him to hire the services of an additional herder. The distance that he travels during a transhumance is long. The distance covered just for the outbound part can be as much as 300 kilometers.

He normally comes back in late June, when the rainy season begins again in Chétimari. Were he to come back sooner, the rainy season would not yet have started and, when the cattle arrived, they would rapidly become exhausted without green grasses. This is also the critical calving time. When pregnant cows experience malnutrition, they may experience miscarriages, or their calves may be more likely to die quickly. This is a major problem. Last year, the government declared that transhumants from Gani had to return home no later than May 20. That year, Moussa lost three calves and he sold, at a very low price, one of his cows that was dying because of placenta retention.


Village et sorgho de décru
Forage et campements d'éleveurs
Bosso
CHÉTIMARI
GANI
Zone densément cultivée
BOULA
Champ de mil
KOLOMANGA
Marché à bétail
Frontière
PARC DE MOUNOUK
Zone inondable
Piste à bétail transfrontalière
Route goudronée
Zone d'accueil des transhumants
MANGA
KOUKA
Quai d'embarquement
LAGUMA

Before arriving in the Manga, Moussa must first pass through a densely populated agricultural area that extends to the international border. It is necessary for him to move fast and ensure that he can have access to an unblocked trans-frontier livestock corridor. Unfortunately, despite current legislation prohibiting land clearance within corridors, there are in fact many fields which encroach, and it is necessary for Moussa to make detours which also exposes him to conflicts with farmers outside the corridors. Last year, where there was a forced deviation because the corridor was blocked at the village of Bula, Moussa had to pay 100,000 FCFA to compensate farmers for damages to their fields. Often, however, such fields are simply traps, cleared in the middle of the bush and not really maintained. They are mainly there to attract animals and justify fines.

Because of the lack of water points and grazing area for the herds, it is also necessary for Moussa to regularly move out of the corridor in order to access the village wells and spend 2 or 3 days in the bush to allow the animals to graze. Cattle rustling at night is a major problem. Moussa must always make camp close to other transhumants for protection. Despite this, however, it is impossible to completely prevent thefts from occurring, especially near the border. The robbers, the theft done, quickly move to the other side of the border and sell the stolen animals on the Manga market.

There is also a trans-frontier wildlife reserve straddling Gani and Manga, through which the trans-border livestock corridor passes. The park is always difficult to cross. Wild animals attack the herds and wound the animals. The situation with the park rangers is also very difficult because, if herders move out of the corridor, they can expect to pay a huge fine. However, sometimes, Moussa has no choice, because his animals become hungry and leave the corridor to graze. At the center of the park, there is also a river that regularly overflows, creating flooded wetlands in which the animals can easily drown.

Once they have arrived in the Manga area with the access to its grazing resources, the months that Moussa will spend in the area still call for extreme levels of prudence. Gani transhumants are not protected and are not much liked by the government. As such, it is common for the local authorities and villages to tax them heavily, whether for access to water or pastures. In addition, because of the proliferation of jackals in the area, the villagers protect their young ruminants by placing poisoned traps everywhere, with the animals owned by the transhumants often falling victim to these.

There are also problems related to grasses and diseases. The grasses which grow around Manga are different from those of Ghani, with some causing poisoning or severe diarrhea in young animals. Foot-and-mouth disease is also found in Manga. While it does not really kill livestock, it does permanently affect herd dynamics. Because of ulcers in the mouth and injuries to the feet, the animals become unable to eat or walk properly during transhumance. This results in many miscarriages and high calf mortality shortly after calving. Like other herders, Moussa uses many medicines to try and fight food-and-mouth disease, but it is never enough.

During this period, Moussa sells animals on the Manga markets, where prices are always more interesting than those in Gani. He generally sells two adult bulls, which allows him to stock-up on cereals and come home with enough to get through the rainy season. However, Gani's meat importation policy is changing and the door is now wide open for cheap frozen meat from South America. Last year, prices for animals from Gani on the Manga markets collapsed and, like many other herders, Moussa was forced to sell at a loss.

Sheep management in Chétimari during the dry season

Moussa's sheep spend the dry season in the Chétimari area under the care of his son. If the rainy season has not been good, this is a difficult period. It is absolutely necessary to fall back on other areas and negotiate with fodder management committees and community councils in order to obtain access to water and pastures, which is often more expensive for outsiders than for local herders. As such, when Chétimari experiences a drought, this often means that Moussa's son will have to sell several additional sheep during the season in order to cover costs.

However, drought is not the only problem. At times, for unexplained reasons, heavy unexpected rainfall sometimes occurs in December or January, well after the rainy season, and in the middle of the cold dry season. For sheep, this is the worst situation, because they often fall sick from the cold. 6 years ago, the government even declared a national disaster. On that day, when it rained, herders tried everything to save their sheep, including bringing them into their houses and making fires to warm them. But all were lost.

Another problem is watering the sheep, because during the dry season, they need to drink every day. To help herds access water during the dry season, in the 1950s the government created a close network (every 20 km) of high-yielding boreholes equipped with pumps. Each can easily water 10,000 heads of livestock per day. However, the facilities are very old. If one pumping station fails, herders must quickly move to another one. If a herder waits too long, his animals will begin to collapse and they will no longer have the strength to walk on. This is particularly the case for sheep, which need to drink every day and are less resistant to walking. Just a few years ago, the borehole near Chétimari broke down and it took more than 10 days to repair it. All of the animals that did not leave in time to go to neighbouring boreholes died of thirst.

Furthermore, the pastoral area is a vast rangeland consisting of annual grasses, with sufficient tree cover to provide adequate foliage for livestock during the dry season. However, it is also a zone which is very exposed to bush fires, which are frequent. In the past, the government maintained large firebreaks that linked the boreholes, forming a protective net. If a fire started somewhere, it could easily be contained. However, over the years, the government withdrew and the local communities do not have the funds necessary to maintain the fire breaks. As such, when there is a bush fire now (whether or not it is accidental) the damage caused is considerable, not only in terms of livestock deaths resulting from the fires or because of the smoke, but also in terms of the destruction of the pastures. A bush fire acts in a similar way as a drought. The burnt grasses will not grow again until the following rainy season, and it is as if it had not rained. Then there is no choice but to leave.

Because of all these problems, the communities have organized themselves to order livestock feed sold at sales-points and stores located near the boreholes. This has proven to be challenging. In Gani, priority for the distribution of livestock feed is given to peri-urban livestock-raising and for livestock fattening, so that it is always very difficult for herders to place orders with the producers of agro-industrial by-products in the capital. For many herders, the only way for their sheep to survive the dry season, depends on timely access to livestock feed, as of the month of March. However, for two years now, the Gani transporters' union has indicated that the transport cost of supplying livestock feed to the north is too costly for the trucks, because the roads are very bad. They thus intend to either reduce the supply beginning next year, or impose a 35% increase on the price per bag on arrival, in order to cover depreciation costs and repairs the trucks. If this were to become the case, many herders are of the opinion that they will have to start going on transhumance with their sheep also.

Moussa's son and the commercialization of livestock

Among Moussa's sons, Samba is the oldest and works as a shepherd for Ibrahim, a livestock trader, who buys animals on local markets in northern Gani and treks them to Manga, which is a coastal country with a high demand for meat. This is a very old livestock marketing value chain, on which many traders operate, especially now with the increased demand for meat in coastal countries resulting from urbanization and improved standards of living. The large market at the end of the supply chain is located on the coast, in Laguma, the capital of Manga. In southern Gani, near the international border, there is the large Kolomanga weekly market, where all of the animals destined to be sold for export to Manga are assembled.

a) The transport of fattened cattle by truck

There are actually two main livestock trading value chains. The first deals with animals that are fattened around the towns in Gani and in the large villages. These are animals that become too heavy to walk once fattened, and they must absolutely be transported by truck. These animals meet a particular demand emanating from the butchers in Laguma who need to meet the needs of the richest people in town who like well-fattened meat. Ibrahim regularly buys young cattle on the local market to fatten them.

By late June, Ibrahim is ready to move his animals. On Kolomanga's market day, he contacts a "truck broker." This is complex work, because there are not really any trucks specifically modified for livestock transportation and, in addition, the trucks are scattered, in different locations. With his cellphone, the broker estimates the number of animals to transport and mobilizes the truckers.

Ibrahim's cattle will join a batch of twenty others from another trader in order to fill a truck and ensure the profitability of the operation. There are usually about forty heads of cattle in a truck. Ibrahim insists on a truck whose side-walls are made of metal rails, instead of wood, as they have less risk of an accident. Indeed, trucks with wooden side-walls tend to roll-over when taking bends on the road and turning corners at speed. Straw is spread out on the flooring to avoid animals slipping during the journey. Loading is done quickly, but is always risky. In total, 10 loaders must participate. On the truck, three helpers will travel with the animals. They remain perched on top of the rails and regularly tap the cattle with a stick to prevent them from lying down. Whether at Kolomanga or during the road trip, animals often incur injuries.

If the truck leaves Kolomanga in the evening, it will only arrive in Laguma the next day, because there are several stages which need to be negotiated. There are check-points and various payments to make on the road, some of which are unofficial. Actually, the association of exporters of Kolomanga has asked the authorities to put an end to this harassment that, when put together, amount to large sums, as well as delaying the trucks, increasing the risk that the animals will die. The most complicated step though, is the border crossing. For two years, the association has been paying a local broker to guide transporters, helping them through the various formalities. If the waiting times are too long, the animals that have not been watered and have not eaten since their departure will begin to show signs of fatigue and, regularly, there are 1 or 2 dead animals on arrival. When the fattened animals reach Laguma, they should at all costs avoid walking, otherwise they will lose weight and may even collapse because of a heart attack. Therefore, Ibrahim must sell them quickly.

Throughout the trip, there is no insurance system. Ibrahim and the other exporters always say that their work is undervalued, because while drivers may drive an old, poorly-maintained truck, they have access to insurance for the vehicles, while the loads they carry (40 head of cattle at 250,000 FCFA a head, amounting to quite a large sum) cannot be protected with any form of insurance, even if only for a short 24-hour period.

b) The transport of animals on-the-hoof.

In addition to fattened cattle, other cattle are generally transported on-the-hoof by herders, such as Samba, Moussa's son. In many ways, such herders are often referred to as commercial transhumants, because they ultimately follow the same routes as other transhumants who travel with their own animals. Moreover, even "standard" transhumants often travel with animals entrusted to them by relatives or other villagers, and which they intend to sell on the Manga markets. Indeed, transhumants are also involved in the livestock trade.

Trekking on-the-hoof requires organization. For several years, there has been insecurity in northern Gani and trekking is tricky because of attacks in the bush, as well as cattle rustling. For these reasons, Ibrahim has been working with the same herders for a long time.

Before organizing a trip, at least 150 heads of cattle must be brought together. For this group, 4 herders and one "boss" are needed. Equipped with a bicycle, the boss transports a part of the luggage, scouts the paths and organizes the meals. With his cell phone, he is also in regular contact with Ibrahim.

The animals are vaccinated before departure. On the day of departure, Ibrahim gives the head transporter an advance for the costs of food and healthcare for both the transporters and the herd. He also gives him 400,000 FCFA for both the official and unofficial fees to pay in order to cross the border with his animals. Ibrahim will follow them at a distance and rejoin them at the exit of Mounouk Park.

The transporters cross Mounouk Park in 7 days, staying away from the tourist trails. However, the water holes in the bush are dry and it is necessary to fall back on the large ponds located in the park. Here, the herd is intercepted twice by rangers and, both times, a fine needed to be paid.

The rest of the journey to Laguma takes two months. The transporters take their time, in order to allow the animals to gain weight and profit from the early pastures of Manga. In fact, their instructions are precisely not to go too fast in order to fatten the animals while walking, a kind of progressive fattening on-the-hoof that is much cheaper than fattening with livestock feed. When there are too many problems near villages, the transporters go closer to the main road. However, accidents with trucks are common and there are always two or three cattle that will die after having been hit by a truck.

Once the herd has reached Kouka, in Manga, the country-side is too densely populated to allow the animals to continue on foot. In Kouka's market, there is a large loading ramp where most animals arriving from Gani are loaded onto trucks that cover the last 80 km before reaching Laguma, the capital. However, these trucks are often in poor condition and accidents are as common as with the trucks that transport fattened cattle. The other problem is the loading ramp at Kouka, which is old and in poor condition. Last year, the ramp collapsed and many animals were unable to be shipped as far as Laguma. They ended up having to be sold at a loss on the local markets.

BIBLIOGRAPHY

GENERAL REFERENCES

Note: references referring specifically to northern-Kenya are shown separately.

AFD, 2011, Gestion des risques agricoles par les petits producteurs, focus sur l'assurance récolte indicielle et le warrantage, Anne Chetaille, Aurore Duffau, Guillaume Horréard, Damien Lagandré, Bastien Oggeri, Ilan Rozenkopf, GRET.

Australian Aid, 2013, The Human and Environmental Impacts of Migratory Pastoralism and Index-Based Livestock Insurance in Arid and Semi-Arid East Africa, Policy Research Overview.

Awel Y., and Azomahou T., 2014, Productivity and welfare effects of weather index insurance: Quasi-experimental evidence, Maastricht University and United Nations University, Paper presented at the International Microinsurance Conference 2014, Mexico City.

Banque Mondiale, 2009, Assurance Agricole (Ramiro Iturrioz).

Banque Mondiale, 2012, Mécanisme Mondial d'assurance basé sur un indice (GIIF) : leçons, expériences de la première décennie de mise en œuvre et perspectives, présentation faite par Fatou Assah, Abidjan.

CEDEAO, Programme régional d'Appui aux Filets de Sécurité Sociaux en Afrique de l'Ouest (avec l'appui du Hub Rural).

Dala A., Gopinah K., Sarfraz S., 2012, A case for Livestock Insurance (India), Micro Insurance Paper 17.

DeAngelis K., World Resources Institute, 2013, Index-based Livestock Insurance: the case of Mongolia, in Inside Stories on Climate Compatible Development, Climate and Development Knowledge Network.

Desjardins Développement International, 2011, Etude sur la micro assurance dans la zone CIMA : état des lieux et recommandations

FAO, 2007, Livestock and aquaculture insurance in developing countries, Agricultural Services Bulletin.

FIDA, 2010, Forage Rainfall Plan en Ontario au Canada, 2014, Etude de cas, *in* L'assurance basée sur un indice climatique : potentiel d'expansion et de durabilité pour le milieu rural

FIDA, 2010, L'assurance basée sur un indice climatique : potentiel d'expansion et de durabilité pour l'agriculture et les moyens de subsistance en milieu rural, par P. Hazell, J. Anderson, N. Balzer, A. Hastrup Clemmensen, U. Hess et F. Rispoli. Rome.

Georges Djohy, Ange Honorat Edja and Tanson Nicole Sarah, 2013, Perception and Adoption Processes Regarding Index-based Insurance for Managing Climate Risks in Agriculture in Benin,Tropentag 2013, Stuttgart, Germany September 17-19, 2013.

Herbold J., 2014, Index insurance for agriculture-separating fact from fiction, Paper presented at the International Microinsurance Conference 2014, Mexico City.

ILOS' Impact Insurance Facility, Réduction des Pertes de l'Assurance Bétail par l'utilisation de puces d'identification électroniques.

Inter-réseaux, 2013, Filets sociaux en Afrique de l'Ouest, des outils en constante évolution, Revue Grain de Sel no 59-62, juin 2013.

International Conference 2007, Mumbai (India), Making insurance work for the poor, Report, edited by Zahid Oureshi and Dirk Reinhard.

International Microinsurance Conference 2005, Munich (Germany), Making insurance work for the poor: Current practices and lessons learnt, Report, edited by Craig Churchill, Dirk Reinhard and Zahid Oureshi.

International Microinsurance Conference 2006, Cape Town (South Africa), Making insurance work for Africa, Report, edited by Dirk Reinhard and Zahid Oureshi.

International Microinsurance Conference 2008, Cartagena (Colombia), Making insurance work for Africa, Report, edited by Zahid Oureshi and Dirk Reinhard.

International Microinsurance Conference 2009, Dakar (Senegal), Making insurance work for Africa, Report, edited by Zahid Oureshi and Dirk Reinhard.

International Microinsurance Conference 2010, Manila (Philippines), Making insurance work for Africa, Report, edited by Zahid Oureshi and Dirk Reinhard.

International Microinsurance Conference 2011, Rio de Janeiro (Brazil), Making insurance work for Africa, Report, edited by Zahid Oureshi and Dirk Reinhard.

International Microinsurance Conference 2012, Daar Salam (Tanzania), Making insurance work for Africa, Report, edited by Zahid Oureshi and Dirk Reinhard.

International Microinsurance Conference 2013, Djakarta (Indonesia), Making insurance work for Africa, Report, edited by Zahid Oureshi and Dirk Reinhard.

International Microinsurance Conference 2014, Mexico City, Closing the protection ap through financial inclusion, Index Insurance Solutions for Emerging Consumers, Swiss Re America Holding Corp, Swiss Reinsurance Company (Munich).

IRAM, 2013, Dispositif de filets de sécurité sociaux en Afrique de l'Ouest : soutenir l'émergence de dispositifs nationaux préventifs, Note Thématique no 7.

Leach J., 2014, From Freemium to Premium: mobile distribution, Bankable Frontier Associates, Paper presented at the International Microinsurance Conference 2014, Mexico City

Luxbacher, Kirsten and Andrew Goodland., 2011 "World Resources Report Case Study. Building Resilience to Extreme Weather: Index-Based Livestock Insurance in Mongolia." World Resources Report, Washington DC

Muller B., Sall M., Leblois A., Balde A., Fall M., Kouakou P., et Affholder F., 2013, L'assurance indicielle en Afrique de l'Ouest : principes, premières realisations et perspectives, Agronomie Africaine Numéro spécial (6) sur les changements climatiques : 95 - 111 (2013).

Muller S., Ramm G., and Steinmann R., 2014, Agriculture, Microinsurance and Rural Development, Microinsurance network, GIZ.

Ndiaye A., 2012, L'assurance agricole au Sénégal, un système en construction, présentation faite dans le cadre du Colloque FARM-Pluriagri : assurer la production agricole, comment faire des systèmes assurantiels des outils de développement?, Paris, 18 décembre 2012

Ndiaye A., N., 2011, Problématique de la couverture du risque agricole en Afrique, communication présentée dans le cadre de la 35ème Assemblée Générale Annuelle de la FANAF, Dakar, 23 février 2011

Organisation des Nations Unies pour l'Alimentation et l'Agriculture, 1966, Le développement de l'agriculture au Japon moderne : portée de l'expérience japonaise, Etude sur la planification agricole numéro 6

Phily C., 2009, Micro Insurance Innovation Facility, Assemblée générale de la FANAF, février 2009, Yamoussoukrou, Côte d'Ivoire.

Quintans D., and al., 2014, Lessons learned form index insurance in Uruguay), Paper presented at the International Microinsurance Conference 2014, Mexico City

Union Européenne, Croissant Rouge Mauritanien, SupAgro-Montpellier, Croix Rouge française, 2013, Etude des effets des transferts monétaires en Mauritanie.

REFERENCES RELATING TO INDEX-BASED LIVESTOCK INSURANCE (IBLI) IN KENYA

Bageant, Elizabeth R. (2014) "Gender Differences in Demand for Index-Based Livestock Insurance" Cornell University, August.

Barrett, Christopher B. (2014) "Index-Based Livestock Insurance (IBLI): On the Positive Impacts of an Imperfect Product" at University of Connecticut. pptx

Barnett, B. J., Barrett C. B. and Skees J. R. (2008) "Poverty Traps and Index-Based Risk Transfer Products," World Development 36 (10), 1766-1785. Link

Barrett, B. C. and McPeak J.G. (2006) "Poverty Traps and Safety Nets," de Janvry A. and Kanbur R. ed. Poverty, Inequality and Development: Essays in Honor of Erik Thorbecke, Springer, Ch. 8. Link

Barrett, C. B. and Luseno W. K. (2004) "Decomposing producer price risk: a policy analysis tool with an application to northern Kenyan livestock markets," Food policy 29, 393-405. Link

Barrett, C. B., Barnett B. J., Carter M . R., Chantarat S., Hansen J. W., Mude A. G., Osgood D. E., Skees J. R., Turvey C. G. and Ward M. N. (2007) "Poverty traps and climate risk: Limitations and opportunities of index-based risk financing." PDF

Barrett, C. B., Carter M. R., Chantarat S., McPeak J. and Mude A. G. (2008) "Altering poverty dynamics with index insurance: northern Kenya's HSNP." PDF

Barrett, C. B., Chabari F., Bailey D., Little D. P. and Coppock L. (2003) "Livestock pricing in Northern Kenyan Rangelands," Journal of African Economies 12 (2), 127-55. Link

Barrett, C., Marenya P. P., McPeak J., Minten B., Murithi F., Kosura W.O., Place F., Randrianarisoa J. C., Rasambainarivo J. and Wangila J. (2006) "Welfare Dynamics in Rural Kenya and Madagascar," Journal of Development Studies 42 (2), 248–277. Link

Carter, M. and Jansen S. (2012) "Coping with Drought: Assessing the Impacts of Livestock Insurance in Kenya". I4 Brief no. 2012 – 01, March. PDF

Carter, M. R. (2009) "Intelligent design of index insurance for smallholder farmers and pastoralists" IFPRI Focus 17 Brief 6, December. PDF

Carter, M. R., Barrett C. B., Boucher C., Chantarat S., Galarza S., McPeak J., Mude A. G. and Trivelli C. (2008) "Insuring the never before insured: Explaining index insurance through financial education games." PDF

Carter, M., Long E., Mude A. (2011) "The IBLI color legend: Translating Index Based mortality predictions into meaningful signals". I4 Brief no. 2011- 02, July. PDF

Chantarat S, Barrett C.B and Mude A.G, (2010) "Developing Index Based Livestock Insurance for Managing Livestock Asset Risks in Northern Kenya" Leap Focus 7, March. PDF

Chantarat S., Barrett C. B., Mude A. G. and Turvey C. G. (2007) "Using Weather Index Insurance to Improve Drought Response for Famine Prevention." American Journal of Agricultural Economics, 89 (5) 1262-1268. Link

Chantarat, S., Turvey C. G., Mude A. G. and Barrett C. B. (2008) "Improving Humanitarian Response to Slow-Onset Disasters using Famine Indexed Weather Derivatives," Agricultural Finance Review 68(1). pdf

Chantarat, Sommarat (2009) "Pro-Poor Risk Management: Essays on the Economics of Index Based Risk Transfer Products" Cornell University, August. pdf

Chantarat, Sommarat, Andrew G. Mude, Christopher B. Barrett, and Michael R. Carter (2013) "Designing Index-Based Livestock Insurance for Managing Asset Risk in Northern Kenya"*Journal of Risk and Insurance*, Volume 80, Issue 1, pages 205–237, March. pdf

Chantarat, Sommarat, Andrew G. Mude and Christopher B. Barrett, (2009) "Willingness to Pay for Index Based Livestock Insurance: Results From A Field Experiment In Northern Kenya," September 2009. pdf

Chantarat, Sommarat, Andrew G. Mude, Christopher B. Barrett and Calum G. Turvey, (2014) "Welfare Impacts of Index Based Livestock Insurance in the Presence of a Poverty Trap." June. pdf

Chantarat, Sommarat, Christopher B. Barrett, Tavan Janvilisri, Sittichai Mudsri, Chularat Niratisayakul, Pilai Poonswad (2011) "Index Insurance for Pro-poor Conservation of Hornbills in Thailand," Proceedings of the National Academy of Sciences, vol. 108, no. 34, August, pp. 13951-13956. link

Doss, C., McPeak J. and Barrett B. (2008) "Interpersonal, Intertemporal and Spatial Variation in Risk Perceptions: Evidence from East Africa," World Development 36 (8), 1453-1468. Link

Hellmuth, M.E., Osgood D.E., Hess U., Moorhead A. and Bhojwani H. (eds) 2009. Index insurance and climate risk: Prospects for development and disaster management. Climate and Society No. 2. International Research Institute for Climate and Society (IRI), Columbia University, New York, USA. PDF

Hirfrfot, Kibrom, Christopher B. Barrett, Erin Lentz, and Birhanu Taddesse (2014) "The Subjective Well-being Effects of Imperfect Insurance that Doesn't Pay out" pdf

Ikegami, M., C. B. Barrett, and S. Chantarat (2012) "Dynamic Effects of Index Based Livestock Insurance on Household Intertemporal Behavior and Welfare" working paper, presented at Africa Growth Forum "Enhancing Agricultural Productivity for Shared Growth in Africa" at Brookings Institute in 2011, at University of California-Davis in 2011, "Hakone Conference on Empirical Micro Development Economics" at GRIPS, Tokyo in 2011, and "Research Conference on Microinsurance" at University of Twente in 2012.

Janzen, S., M. R. Carter, M. Ikegami (2013) "Valuing Asset Insurance in the Presence of Poverty Traps" presented at NEUDC 2012, 2012 AAEA Annual Meeting, the Pacic Development Conference 2012, the 7th International Microinsurance Conference, and the I4 Technical Meeting 2011. pdf

Janzen, Sarah A. and Michael R. Carter (2013) "After the Drought: The Impact of Microinsurance on Consumption Smoothing and Asset Protection." NBER Working Paper No. 19702. link

Janzen, Sarah Ann (2013) "Insuring Against a Poverty Trap" University of California, Davis, link

Jensen N., SheahanaM, Barrett B C. , and Andrew Mude. November 2014. "Hunger Safety Net Program (HSNP) and Index Based Livestock Insurance (IBLI) baseline comparison" HSNP_IBLI_Comparison pdf

Jensen, Nathaniel D., Andrew G. Mude and Christopher B. Barrett (2014) "Index Insurance and Cash Transfers: A Comparative Analysis from Northern Kenya" at Cornell University. pptx

Jensen, Nathaniel D., Christopher B. Barrett and Andrew G. Mude, "Basis Risk and the Welfare Gains from Index Insurance: Evidence from Northern Kenya," September 2014. pdf

Jensen, Nathaniel D., Christopher B. Barrett and Andrew G. Mude, "How Basis Risk and Spatiotemporal Adverse Selection Influence Demand for Index Insurance: Evidence from Northern Kenya. link

Jensen, Nathaniel Duane (2014) "Basis Risk, Uptakes and Impacts of Index Based Livestock Insurance in Northern Kenya" Cornell University, August.

Little, P.D., McPeak J., Barrett C. B. and Kristjanson P. (2008) "Challenging Orthodoxies: Understanding Poverty in Pastoral Areas of East Africa," Development and Change 39 (4), 587-611. Link

Lybbert, T. J., Barrett C. B., Desta S. and Coppock D. L. (2003) "Stochastic wealth dynamics and risk management among a poor population," Economic Journal 114, 750-777. Link

Lybbert, Travis J., Francisco B. Galarza, John McPeak, Christopher Barrett, Steve R. Boucher, Michael R. Carter, Sommarat Chantarat, Aziz Fadlaoui, Andrew Mude (2010) "Dynamics of Field Experiments in Developing Economics: Risk Valuation in Morocco, Kenya and Peru" *Agricultural and Resource Economics Review,* 39/2 pp.1–17. April. pdf

Mahul, O. and Skees J. (2007) "Managing agricultural risk at the country level: the case of index-based livestock insurance in Mongolia." PDF

McPeak, John, Sommarat Chantarat, Andrew G. Mude (2010) "Explaining Index Based Livestock Insurance to Pastoralists," *Agricultural Finance Review*, Vol. 70 Iss: 3, pp.333 – 352. link to abstract. pdf of working paper version.

Mintz S., 2014, Takataful, Insurance Designed for Muslim Herders in Kenya, Reuters Foundation, London.

Mude, A., Chantarat, S., Barrett, C., Carter, M., Ikegami, M. and McPeak, J. (2011) "Insuring Against Drought-Related Livestock Mortality: Piloting Index-Based Livestock Insurance in Northern Kenya" in *Towards Priority Actions for Market Development for African Farmers: Proceedings of an International Conference*. 13-15 May 2009, Nairobi, Kenya. AGRA and ILRI, Nairobi, Kenya. pp. 175-188.

Mude, Andrew G., Christopher B. Barrett, Michael R. Carter, Sommarat Chantarat, Munenobu Ikegami and John G. McPeak, "Project Summary: Index Based Livestock Insurance For Northern Kenya's Arid and Semi-Arid Lands: The Marsabit Pilot," January 2010. PDF

Skees, J. R. and Collier B. (2008) "The Potential of Weather Index Insurance for Spurring a Green Revolution in Africa

Takahashi, Kazushi, Munenobu Ikegami, Megan Sheahan, Christopher B. Barrett (2014) "Quasi-Experimental Evidence on the Drivers of Index-Based Livestock Insurance Demand in Southern Ethiopia." IDE Discussion Paper No. 480. pdf

Toth, Russell, Chris Barrett, Richard Bernstein, Patrick Clark, Carla Gomes, Shibia Mohamed, Andrew Mude, and Birhanu Taddesse. August 2014. "Environmental Spillovers of Index-Based Livestock Insurance" pdf

Toth, Russell. Forthcoming. "Traps and Thresholds in Pastoralist Mobility." American Journal of Agricultural Economics. link to working paper version