KENYA: AGRICULTURE INSURANCE SOLUTIONS APPRAISAL

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ACRONYMS

AIDP: Agriculture Insurance Development Program
AIM: Agricultural Insurance Manager
ARC: Africa Risk Capacity
ASAL: Arid and Semi-Arid Lands
ALRMP: Agricultural Land Reform Management Program
ARMA: Agricultural Risk Management Agency
AYII: Area Yield Index Insurance
AWS: Automated Weather Stations
CCE: Crop-Cutting Experiments
DFID: Department for International Development
DRFIP: Disaster Risk Financing and Insurance Program
eMODIS: enhanced' Moderate Resolution Imaging Spectroradiometer
FGD: Focus Groups Discussions
FSD: Financial Sector Deepening
GFDRR: Global Facility for Disaster Risk Reduction and Recovery
GIS: Geographic Information System
GIZ: Gesellschaft für Internationale Zusammenarbeit
GoA: Government of Argentina
GoK: Government of Kenya
GoU: Government of Uruguay
GMR: Guaranteed Minimum Return Scheme
GPS: Global Positioning System
HBA: Historical Burn Analysis
HSNP: Hunger Safety Net Program
KMD: Kenya Meteorological Department
KNSB: Kenya National Bureau of Statistics
KSh: Kenyan Shilling
IBLI: Index Based Livestock Insurance
IRA: Insurance Regulatory Authority
ILRI: International Livestock Research Institute
IU: Insurance Unit
MALF: Ministry of Agriculture, Livestock, and Fisheries
MFI: Microfinance Institution
MPCI: Multi-Peril Crop Insurance
MoA: Ministry of Agriculture
MoF: Ministry of Finance
NAIP: National Agricultural Insurance Policy
NT: National Treasury
NDVI: Normalized Difference Vegetation Index
NPCI: Named Peril Crop Insurance
SACCO: Savings and Credit Co-operative
SFSA: Syngenta Foundation for Sustainable Agriculture
SDA: State Department of Agriculture
SDL: State Department of Livestock

TLU: Tropical Livestock Units
TSU: Technical Support Unit
PPP: Public Private Partnership
USAID: United States Agency for International Development
WB: World Bank
WII: Weather Index Insurance

INTRODUCTION

This Agriculture Insurance Solutions Appraisal proposes the technical concept of a potential public private partnership (PPP) in agricultural insurance in Kenya, covering both crop and livestock. To go about this, it lays out the rationale for the proposal, proposes an insurance PPP solution for the thus identified challenges, and makes a suggestion for the required underlying institutional framework. This document shall guide the further policy making and technical development processes and form the basis for further discussion among all involved stakeholders.

In Kenya agriculture is risky, and that risk has large human and economic costs. Agriculture is key to the Kenyan economy, generating approximately 24% of annual GDP and approximately 50 percent of revenue from exports. It is also an important source of employment, with over 70% of the population living in rural locations of which approximately 5 million[1] are farmers and herders. However, agriculture is risky, often unirrigated, and given that agriculture is a climate-sensitive activity, it is highly vulnerable to the impacts of climate change.

Despite the recognized need for a commercially-oriented, internationally competitive and modern agricultural sector, rural lending in Kenya is low. Agricultural lending accounts for only 4.3% of total lending in Kenya in 2012[2]. A large-scale agricultural insurance program could support resilient, viable expansion of agriculture credit to farmers by removing agriculture risk from the balance sheet of rural banks and cooperatives, thereby ensuring they are more robust to agricultural shocks. Without adequate coverage of agricultural insurance, agriculture credit will continue to be insufficient to fully meet the needs of farmers and herders.

Moreover, international experience suggests that agricultural insurance programs will not scale up unless based on a balanced partnership between the public and private sectors. In recent years numerous private sector agricultural insurance pilots have been implemented in Kenya with support from donor partners for index-based crop insurance. However, to date most of these programs have failed to reach significant scale. Overall, experience from other countries suggests that it is critical to have both the government and the private sector play a role in developing the agriculture insurance market[3].

[1] Kenya Vision 2030
[2] 2012 Annual Report, Central Bank of Kenya
[3] See Mahul and Stutley 2010 for a comprehensive review of government support to agricultural insurance

Recognizing its need for involvement, the Government of Kenya (GoK) requested the Agriculture Insurance Development Program (AIDP), which is part of the Disaster Risk Financing and Insurance program (DRFIP), to investigate how agriculture insurance, as part of a broader risk management framework, could form part of Government's strategy to de-risk agriculture value chains and realize the vision for a mid-long term transformation of the agriculture sector in Kenya, increasing food security, economic growth and shared prosperity. GoK has identified the agriculture sector as a key area of focus under the Kenya 2030 plan to enable the transition of Kenya to a middle income country, and agricultural insurance is a stated priority of government, as reflected in the Medium Term Plan II. Government is exploring initiatives to further de-risk the agriculture sector value chain in order to better enable access to markets and unlock access to credit to allow farmers to purchase higher yielding technology (seeds, fertilizers, plants protection chemicals, etc) and to increase their incomes. These initiatives aim to simultaneously ensure food security in Kenya and transform the agriculture sector.

Responding to this need, the AIDP has developed the following technical report, investigating the institutional policy and design issues, the fiscal cost and welfare benefit of potential agriculture insurance PPP structures. Building on the current landscape in Kenya with regards to agriculture insurance policy and government institutions, analysis was conducted to understand the potential paths forward for GoK in forming a sound policy and institutional structure to unlock the innovative potential of the private sector in agriculture insurance. For both crop and livestock, the current market was analyzed to understand what is feasible in the short, medium and long term in regards to developing high quality products to meet client needs.

BOX 1: KEY LESSONS FOR THE DESIGN AND IMPLEMENTATION OF AGRICULTURAL INSURANCE

- Agricultural insurance programs are challenging to develop and successfully sustain.
- Carefully designed and well implemented agricultural insurance programs can support a range of government policy objectives such as increased access to credit, improved agriculture productivity, reduced vulnerability, and social protection.
- Agricultural insurance should be considered by government alongside other potential agricultural risk management and social protection interventions, as other interventions may offer higher benefit-cost ratios or be a precondition for successful agricultural insurance.
- Agricultural insurance programs are more effective and efficient when underwritten by the private insurance sector and actively supported by government under carefully-designed public-private partnerships (PPPs).

- Financial support to agricultural insurance programs can provide better incentives and a faster, more cost-effective way of supporting agricultural producers to recover from shocks than ad hoc post-disaster relief.
- Cost sharing between government, donors and farmers may be different for different segments of the population, according to policy priorities.

Sources: Mahul & Stutley 2010; AIDP 2014

1 INSTITUTIONAL FRAMEWORK

1.1 RATIONALE FOR PUBLIC PRIVATE PARTNERSHIPS (PPPS) IN AGRICULTURAL INSURANCE

The agricultural insurance market in Kenya has failed to reach scale. With the exception of some small-scale pilots and niche retail activity, the private sector is currently not providing agricultural crop and livestock insurance. This Chapter considers possible causes of the failure of the agricultural insurance market in Kenya, the rationale for, and the benefits of, a public private partnership (PPP) in developing agricultural insurance and the appropriate functions of the public and private sectors within a PPP. The final section suggests a vision for a PPP and makes recommendations for next steps.

Weather Index Insurance (WII) has, in the recent past, been viewed as offering a potential solution for promoting the development of a viable agricultural insurance market, however has achieved mixed results. Although a number of small-scale agricultural insurance pilots have been commenced, only one, the UAP Syngenta program, has so far scaled-up. This program, which is now in its fifth full year of implementation, has achieved about 100,000 policy sales in Kenya, Uganda and Rwanda, where there is specific automatic linkage between crop WII and crop-credit provision. The reasons for the lack of scale-up of WII in Kenya were considered in a Review of the Financial Sector Deepening Programme published in July 2013. The authors concluded that there remain substantial challenges to establishing viable index insurance for smallholder farmers on a retail basis at scale. In their view, a number of fundamental building blocks required for building an agricultural insurance market are not in place. These building blocks include: (i) improved access to inputs, husbandry and irrigation; (ii) ensuring reliable access to weather data; and (iii) a supportive regulatory framework.

Whilst these building blocks are important, international experience[4] suggests that there are other reasons for the failure of agricultural insurance markets and for the failure of pilots to scale up. Most of these are equally applicable to Kenya:

- **Lack of agriculture data.** As considered later in this Chapter, there is very little reliable agricultural data available in Kenya. This is a serious constraint on the development of agricultural insurance products.
- **Lack of capacity especially for catastrophe risk.** Insurers do not have the capacity to cover catastrophe risk associated with drought, flood and other typical agricultural risks. Although international reinsurance is available, it is expensive, particularly where there is a lack of data.

[4] See in particular Kerer 2013.

- **High distribution costs.** Given that farms tend to be small and spread over wide areas, agricultural insurance typically carries very high distribution costs. These are exacerbated by the lack of established branch or agent networks in the rural areas.
- **High loss assessment costs.** In relation to traditional indemnity insurance, the costs of assessing losses are usually extremely high, particularly in relation to small insured farm units, where the premium volume generated is usually very low and insufficient to cover the costs of the loss assessment.
- **High development costs.** Index insurance, although lowering the transaction cost, carries extremely high development and other start-up costs. These start-up costs cannot usually be justified by commercial insurers, especially on an individual basis.
- **Affordability of premiums.** Small farmers are unwilling, and may be unable, to pay for commercially priced agricultural crop and livestock insurance.
- **Farmers in Kenya have a poor understanding of insurance.** This reduces the demand for agricultural insurance and may lead to farmers buying, or being sold, inappropriate products.
- **Lack of an enabling legal and regulatory framework.** As considered later in this chapter the Insurance Act does not support index insurance[5] and a regulatory framework for microinsurance is still being developed.

Furthermore, flaws in the design of post-disaster relief often result in the crowding out of insurance. If famers expect post disaster relief from government, development agencies or NGOs, they have little incentive to purchase insurance.

International experience suggests that sustainable, scaled up agricultural insurance programs are based on a strong partnership between the public and private sectors, with engagement, innovation, and action from both sectors. Although the failure of the agricultural insurance market in Kenya provides a clear justification for GoK intervention, public sector-only (and private sector-only) approaches suffer from severe challenges, ranging from inefficient delivery, distribution, and claims settlement in the case of the former and underinvestment in the data necessary for the development of quality insurance products in the in the case of the latter. Thus, for Kenya, a strong partnership between the public and the private sectors is recommended to build on the comparative advantages of the respective sectors.

1.2 PUBLIC AND PRIVATE SECTOR FUNCTIONS

OVERVIEW

Few functions are exclusively public sector or exclusively private sector functions, but rather shared functions. For example, both the public sector and private sector have separate functions in relation to data, marketing and outreach and risk financing. The

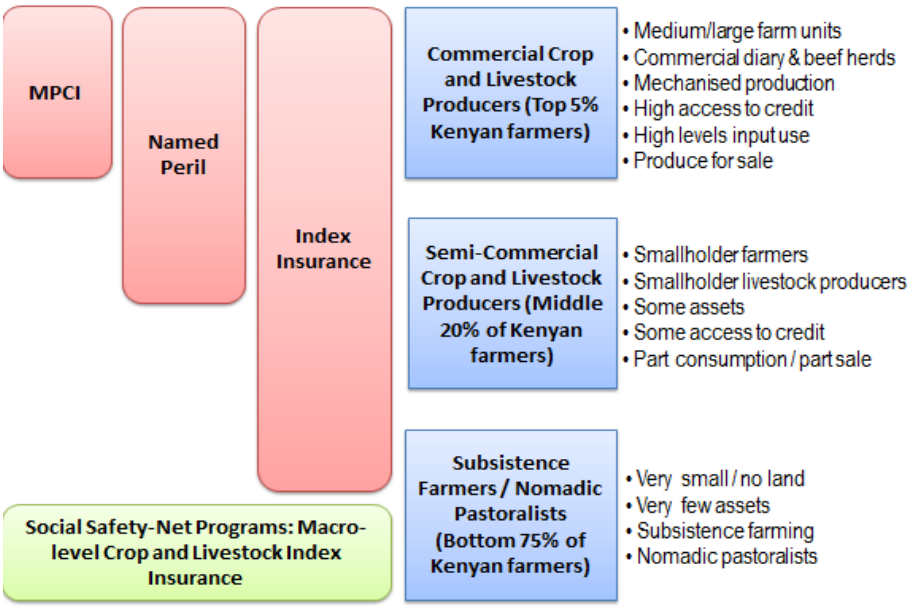
[5] Although support for index insurance is included in a proposed Bill for a new Insurance Act.

shared nature of the functions strengthens the arguments for a PPP framework but will also influence the design of the institutional framework.

The PPP framework for agricultural insurance and wider risk management will need to support public and private sector institutions to identify, develop and distribute the appropriate risk transfer solution to each segment of the farming population. Currently most traditional indemnity-based crop and livestock insurance in Kenya is targeted at small to medium size commercial farmers and dairy cattle producers and whilst index insurance is being promoted by the donors as a small-scale farmer micro-insurance or retail product. Most of these programs are not achieving scale.

Traditional indemnity based multi peril crop insurance (MPCI) is not well suited to the risk transfer needs of subsistence farmers and pastoralists. It is therefore necessary to identify other risk transfer solutions for these farmers and pastoralists. In the short to medium term, potential linkages between existing social safety net programs and applications of macro-level index insurance programs could be explored as part of an integrated risk management framework. (Figure 1).

FIGURE 1: TOWARDS AN INTEGRATED PRIVATE RISK MANAGAMENT AND INSURANCE FRAMEWORK FOR DIFFERENT SEGMENTS OF KENYA'S CROP AND LIVESTOCK PRODUCERS

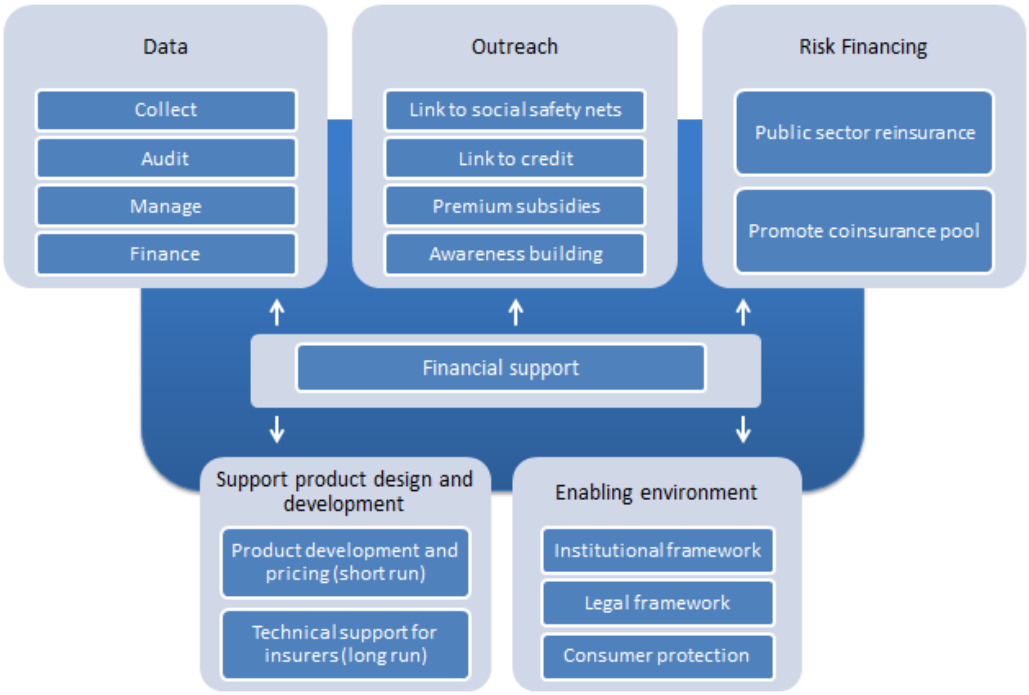


Source: MALF 2014

The Kenyan agricultural insurance market is subject to market inefficiencies that GoK can help to overcome through a number of mechanisms. These mechanisms may include: (i) the collection of reliable agricultural insurance data, (ii) appropriate outreach to potential policyholders, (iii) providing, or supporting, the risk financing of the catastrophic

layer of reinsurance, (iv) supporting the design of appropriate insurance products, and (iv) establishing and implementing an enabling legal and regulatory environment.

FIGURE 2: POTENTIAL PUBLIC SECTOR ROLES FOR GOK TO CONSIDER IN SUPPORT OF AGRICULTURAL INSURANCE DEVELOPMENT IN KENYA



The full participation of the private sector is critical for the successful implementation of an agriculture insurance program. The following are considered to be principally private sector functions: (i) product design and rating, (ii) risk acceptance and underwriting, (iii) decisions over risk retention and reinsurance strategies, (iv) supplementary data collection and (v) the marketing and (vi) distribution of crop and livestock insurance products. As indicated in the Overview section of this Chapter, many functions are shared private sector/public sector functions. Both risk financing and data collection are also public sector functions and, although product design and rating is a private sector function, where Government is providing subsidy, it will have a strong interest in the price of the product and therefore in how the product has been rated.

Product development and on-going technical support is costly. Given the actuarial and other specialist expertise required to design and price new actuarially sound and sustainable agricultural insurance products and to support their development on an on-going basis, the costs are likely to impose a significant entry barrier to commercial insurers. Insurers expect to recover product development costs through the premium paid, over time. However, in the case of agricultural insurance the high costs and the limited financial capacity of policyholders make this unrealistic. Therefore, although product development and technical support are private sector functions, the support of Government together

with development institutions (such as ILRI, the World Bank, DFID and USAID) is likely to be necessary, at least in the short to medium term.

Care will need to be taken to mitigate the risks of crowding out private sector innovation or to providing a subsidy for tasks which the private sector is able to undertake. Once products have been developed and demonstrated to be actuarially sound, insurers should be able to support their continued development and once agricultural insurance has reached scale, the premiums should be able to support the costs of developing new products without public sector support.

FUNCTIONS OF THE PUBLIC SECTOR

DATA COLLECTION, AUDITING, AND FINANCING

Effective insurance solutions require good quality data and without good quality data, insurance markets are unlikely to develop in a sustainable manner. To be of sufficient quality for insurance purposes, data must be sufficient and adequate to enable products to be designed and rated, relevant (so that the product offers reliable protection), reliable enough to be acceptable to international reinsurers, whether through audit or otherwise, timely (so that claims can be paid quickly) and cost-effective.

The different categories of risk and the different insurance schemes in Kenya require different types, and investments in, data. For example, crop and livestock insurance require different types of data, which may be available from different sources (such as ground based or satellite / remote sensing data on agricultural production or weather variables).

It is recommended that GoK plays an important role in collecting agricultural insurance data, both for livestock and for crop insurance. Given that the collection and management of most data for agriculture insurance is expensive and non-rivalrous[6], the function is usually more efficiently undertaken through a monopoly. For example, it does not make economic sense for every insurer to set up its own weather stations in the same area to capture the same data. Thus, the public sector has a natural role to play. In Kenya, as many countries, this has led to the collection of agricultural insurance data being largely coordinated by government agencies. This is true for all agricultural insurance data apart from claims data that is collected by insurers themselves (see below). There may be other sources of data, but the main responsibility lies with public sector institutions as represented in Table 1.

TABLE 1: AGRICULTURAL INSURANCE DATA AS COLLECTED BY GOK

Data Type	Public Institution in Charge of Collection

[6] Non-rivalrous goods may be consumed by many at the same time at no additional cost (e.g. national defense or a piece of scientific knowledge).

Meteorological data	**Kenya Meteorological Department (KMD)** under the Ministry of Environment, Water, and Natural Resources
Time Series crop production and yield data	**Kenya National Bureau of Statistics (KNBS)** and **Ministry of Agriculture, Livestock, and Fisheries (MALF)**
Crop and Livestock damage data	**MALF**
Further livestock statistics	**Agricultural Land Reform Management Program (ALRMP)** and **USAID's Pastoral Risk Management Project**

GoK could investigate the benefits of outsourcing some parts of the data collection to private providers. In India, for example, crop-cutting experiments (CCEs) that support area yield indices for insurance are outsourced by several state governments to private sector agents, although it is too soon to judge whether this will be successful. Outsourcing does not make the activity a private sector function but rather an outsourced public sector function. This is an important distinction as ownership of the function suggests control and where public functions are outsourced, greater checks and balances will need to be built into the structure to protect the public sector interest.

The quality of most publicly collected agricultural insurance data is perhaps not of insurable quality. Data is often incomplete, missing, or unavailable. The MALF / GIZ report has listed various reasons for this:

(i) Data collection coverage is low: While the KMD operates 92 synoptic, agro-meteorological and Automatic Weather Stations (AWS) across Kenya, the MALF / GIZ report estimates that to achieve total coverage of Kenya, more than 1250 AWS would be required. Also, they are mainly located in the major towns in the central and Southern regions;
(ii) There has not been a farm-level census since 1999;
(iii) MALF Field Extension Officers are under-funded;
(iv) MALF data on crop production seems to be unavailable or not systematically maintained.

Given the lack of high-quality agricultural data, a strong audit is necessary in Kenya to ensure data quality and access to international reinsurance markets. Agricultural shocks are covariate in nature and access to international reinsurance markets is important to off-load some of this risk outside the country. However, reinsurers have high standards for the data they are willing to use to develop and price insurance products, and will charge significantly higher premiums if they have concerns about how the data is audited. Therefore, it is important that agriculture data is audited through a transparent process. This will allow local insurers to leverage international reinsurance markets.

Given the lack of high-quality agricultural data, a strong audit mechanism on data is necessary in Kenya to ensure data quality and access to international reinsurance markets. Some of the concerns are in the process of being addressed through a series of

data collection guidelines developed by GoK, which are currently under review. These include the Kenya Agricultural Data Collection and Management Guideline, a complementary Training Manual, and a list of standards and guidelines for food and agricultural data collection. However, much work remains to be done, including (i) the implementation of said guidelines, (ii) providing for integrated databases of agricultural insurance data, and (iii) introducing clear protocols regarding access to agricultural insurance data and the charges that are levied on such data.

The discussion above suggests that considerable investment is required in the collection, management and audit of data. In order to avoid wasted investment, it would be prudent to undertake a preliminary analysis of the data available from public and private sector sources in Kenya. This could be used to direct efforts towards:

(i) the production of a data "gap analysis";
(ii) a determination of the types of agricultural insurance products that can be designed with minimum investment in the data infrastructure to fill the data gaps;
(iii) the extent to which data can be sourced externally as a substitute for local data (e.g. satellite / remote sensing data).

OUTREACH

It is recommended that GoK provide general outreach support in relation to agricultural insurance products with the objective of expanding market awareness. Achieving scale is fundamental to the sustainability of agricultural insurance programs as this enables the costs of provision to be spread among numerous policyholders. However, low levels of financial literacy in the target market and poor understanding of the potential benefits of insurance often prevent programs from reaching scale. Although the marketing of specific insurance products is a function of the private sector, not Government, Government can play a more general role aimed at building (1) financial literacy among potential policyholders and (2) an understanding of the types and potential benefits of agricultural insurance.

Caution must be exercised in relation to the exercise of this function by Government. Experience has shown that Government consumer education and marketing campaigns may be unsuccessful and even counter-productive if the insurance products are not available (for example because insurers do not have the necessary distribution channels in place) or if insurers are not trusted, for example through slow claims payment and low claims ratios. Therefore, when considering the development of financial awareness campaigns, it is important to ensure that associated products are also developed and offered in tandem.

It is recommended that GoK consider various ways to support outreach for agricultural insurance products:

(i) **Linkage to rural lending:** Rural banks and microfinance institutions (MFIs) have the potential to reach a large number of rural farmers in Kenya. Linking agriculture insurance to rural credit can have the potential to achieve wide scale outreach, while

at the same time deepen access to financial services through the provision of both credit and insurance. The imposition of a legal obligation to purchase insurance on taking agricultural insurance can lead to poor incentives. However, banks may impose the requirement as part of the package that they offer to farmers and this can be supported by government.

(ii) **Financial literacy campaigns:** Unless potential policyholders have a basic level of financial literacy, it will be impossible for insurers to sell agricultural insurance products. With a greater degree of financial understanding, farmers can better weigh the risks and benefits of insurance products. Again, it is expected that County Governments will play an essential role in this.

(iii) **Raising awareness of insurance:** Beyond basic financial literacy, potential policyholders will not purchase insurance without an understanding of the types and benefits of agricultural insurance. This should be regarded as a shared role. Government may be better able to utilise the media, such as radio, newspapers and TV. However, this is not likely to be effective unless the private sector also plays a role, by providing effective training to insurance agents and by developing clear product documentation.

(iv) **Linkage to the Hunger Safety Net Program (HSNP):** Linking livestock insurance to the HSNP should help to increase outreach by the targeting of insurance (through poverty data). This linkage will also serve to lower transaction costs, by enabling a more efficient collection of premiums and distribution of claims.

Although the Insurance Regulatory Authority is already engaged to a limited extent in raising public awareness of insurance, it is considered that GoK and County Governments also have roles to play. In relation to financial literacy and market awareness campaigns, the development of a strategy is a function of GoK, the function of the Country Governments being to lead implementation through the devolution process.

RISK FINANCING

Due to factors already discussed, such as high development costs, high distribution costs, high claims assessment costs and high risk financing costs, agricultural insurance is unlikely to succeed without some public sector subsidy. Development costs are an upfront charge, distribution costs can be mitigated through the development and use of alternative distribution channels and claims assessment costs can be mitigated through product design. However, the cost of financing the risk has to be met on an on-going year-to-year basis. An insurance product cannot be sustainable unless the risk financing costs are fully met. It is therefore perhaps inevitable that the public sector will have to provide support for risk financing.

Insurance may be used by Governments as an efficient mechanism for providing financial support to vulnerable farmers and pastoralists in the event of crop failure or significant livestock losses. Well-designed insurance products are an efficient method of transferring extreme agricultural risk. However, agricultural insurance is unlikely to be

purchased by vulnerable farmers and pastoralists. In these circumstances, governments may decide that purchasing insurance on behalf of those farmers and pastoralists is more efficient than other support mechanisms, such as the provision of post disaster relief.

Governments often provide support for the financing of risk through direct premium subsidies with the objective of incentivising insurers to enter the market and increasing the take-up of insurance products, and therefore outreach. However, there are potential drawbacks with this approach and, if this is the objective, there may be better ways for government to reduce the premium cost to farmers than direct premium subsidies, such as through risk financing.

Consideration should be given to the provision by GoK of a stop-loss reinsurance to help manage the covariate nature of catastrophic risk. Given that much agricultural risk is associated with weather risk, pests or disease, all of which can have widespread effect, insurers writing agricultural insurance are exposed to, potentially significant, catastrophic risk. Catastrophe risk is usually the most expensive layer of risk due to the need for a higher capital loading, even where high quality data is available. The loading is increased significantly if the data is of poor quality as insurers and reinsurers must add an uncertainty loading into the price. International experience has demonstrated the efficiencies gained by splitting the risk into layers. For example, under the Mongolian livestock insurance scheme, which has now reached national scale:

(i) The first layer of risk (up to 6% livestock mortality), which covers the more frequent low impact events, is borne by the insured livestock herders.
(ii) The second layer of risk (between 6% and 30% livestock mortality) is covered by commercial insurers, through a pool, for which the policyholders pay a fully priced rate[7] (the non-catastrophic layer of risk).
(iii) The third layer of risk (over 30%), (i.e. the catastrophic layer of risk), is covered by the Government under a stop los agreement entered into with the commercial insurers. The Government does not make any charge for the stop loss agreement.

The commercial insurers reinsure part of their liability under the commercial layer to the international reinsurance market and, similarly, the Government reinsures a portion of its risk under the catastrophic layer to the international reinsurance market.

This form of risk layering offers a number of advantages. These include the following:

(i) The Government, by covering the catastrophic layer of risk, is *reducing the premium paid by farmers*, as the premium does not include the price of the catastrophic risk, which lowers the cost of the insurance to insured livestock herders.

7 Including the full price of the risk and an administrative loading to cover the ongoing costs of the insurers, although not the development costs.

(ii) *If the Government decides to withdraw the subsidy the non-subsidised commercial layer can still continue to be sold on a sustainable basis*, as the non-catastrophic risk is fully priced. This will cover all but the catastrophic risk.
(iii) *Significant efficiencies are obtained* through the effects of risk pooling at the national level, in both the commercial layer and the catastrophic layer.
(iv) *Government can optimize the cost of capital by managing the amount and type of reinsurance, or other types of risk transfer instruments, that it purchases*. By selectively transferring a portion of the catastrophic risk to the international market, and retaining the balance of the risk, the total costs to Government of providing an indirect premium subsidy are significantly less that if the Government sought to achieve the same effect by direct premium subsidy.

This risk financing approach could be considered for crop insurance in the Kenyan context. Due to the limited availability of data and need to develop affordable products for farmers, GOK playing a role in risk financing could allow for significant benefits for a crop insurance program. In order to achieve the most efficient pricing for the risk, it is recommended that, in the medium term, the Government considers a risk layering approach similar to that used in Mongolia under which it provides support for the higher layers of risk.

For livestock insurance, as the objective is to reduce the vulnerability of pastoralists, direct premium subsidy may be necessary in the short term. In the initial years, any livestock insurance product shall be based on high quality satellite data which would not be subject to large increases in the premiums for poor data quality[8]. In addition, as the primary objective of the livestock insurance program is to reduce vulnerability of households in the ASAL regions, the beneficiaries will be low-income households who would not be able to afford to pay for the insurance. Thus GOK providing premium subsidies could be considered as a viable option however, it is recommended that these should be clearly targeted and options considered for their gradual withdrawal over time.,

The provision of agricultural insurance through coinsurance pools is recommended later in this Chapter. Although the establishment of non-statutory coinsurance pools is a private sector function, the initial drive for this may need to come from the public sector. Below more details.

SUPPORT FOR THE DESIGN AND ON-GOING DEVELOPMENT OF INSURANCE PRODUCTS

As stated above, there may be need for public sector support in product development and on-going technical support in the short to medium term, with the support of Government together with development institutions (such as ILRI and the World Bank).

[8] Reinsurance companies will add, often large, "data uncertainty" increases to insurance premiums if they do not feel the data is of high enough quality, thus significantly increasing the cost for farmers.

That said, care will need to be taken to mitigate the risks of crowding out private sector innovation or of providing a subsidy for tasks which the private sector is able, and would otherwise be willing, to undertake. Once products have been developed and demonstrated to be actuarially sound, insurers should be able to support their continued development and once agricultural insurance has reached scale, the premiums should be able to support the costs of developing new products without specific public sector support for this.

SUPPORT FOR THE DESIGN AND ON-GOING DEVELOPMENT OF INSURANCE PRODUCTS

Product development and on-going technical support is costly. Given the actuarial and other specialist expertise required to design and price new actuarially sound and sustainable agricultural insurance products and to support their development on an on-going basis, the costs are likely to impose a significant entry barrier to commercial insurers. Insurers expect to recover product development costs through the premium, over time. However, in the case of agricultural insurance the high costs and the limited financial capacity of policyholders make this unrealistic. Therefore, although product development and technical support are private sector functions, the support of Government together with development institutions (such as ILRI and the World Bank) is likely to be necessary, at least in the short to medium term.

Care will need to be taken to mitigate the risks of crowding out private sector innovation or of providing a subsidy for tasks which the private sector is able, and would otherwise be willing, to undertake. Once products have been developed and demonstrated to be actuarially sound, insurers should be able to support their continued development and once agricultural insurance has reached scale, the premiums should be able to support the costs of developing new products without specific public sector support for this.

SETTING AND IMPLEMENTING AN ENABLING LEGAL AND REGULATORY ENVIRONMENT

A number of general considerations should be taken into account. Traditional indemnity-based agricultural insurance is a line of general insurance that should be regulated just as any other line of insurance, although special regulatory provisions may be required in relation to catastrophe risk. Recognising that the current Insurance Act and Regulations do not enable Kenya to comply with international standards, the Insurance Regulatory Authority (IRA) has led the process to develop a new Insurance Bill and Insurance Regulations that would enable substantial compliance with international standards.

It is necessary to establish an appropriate legal framework for index insurance. The position in relation to index insurance is somewhat different. Given that index insurance pays against an agreed index rather than on the basis of actual losses, there has been

considerable discussion internationally as to whether index risk transfer products can be properly classified and recognised as insurance at all. As the current Insurance Act does not recognise index-based insurance, the introduction of index insurance products carries both legal and regulatory risk. It is understood that the proposed new Insurance Bill, as drafted, provides that, subject to certain general criteria, index risk transfer products can be classified as insurance. The Bill also provides for the Authority to make supporting Regulations concerning index insurance. The enactment of the Bill would significantly reduce the legal risks associated with the development of new index insurance products. It is recommended that the Government expedite the legislative process.

The primary responsibility for the implementation of the legal and regulatory framework for insurance lies with the IRA. Once the new Insurance Act has been enacted, the IRA will need to issue appropriate Regulations.

It is recommended that the IRA consider including at least the following in relation to index insurance:

(i) Detailed criteria for determining whether an index product can be classified as insurance.
(ii) Enabling and providing for composite (i.e. index and traditional) products and dual trigger products.
(iii) General requirements in relation to indexes aimed at reducing basis risk.
(iv) Restrictions on persons to whom index insurance may be sold (aimed at ensuring an appropriate insurable interest).
(v) Key requirements for issues to be included in the policy document.
(vi) Specific provisioning requirements.
(vii) Consumer protection requirements.

The issuance of Regulations will significantly mitigate the regulatory risk associated with index insurance.

Consumer protection is relevant to both traditional and index insurance. Consumer protection concerns are often exacerbated in a rural context, where farmers lack financial literacy and a full understanding of both the product details and the broader implications. It is recommended that the IRA issue consumer protection regulations that cover, at least, the following:

- poor value products
- lack of disclosure
- unfair contract terms
- delays in insurance payments

A number of countries have specific agricultural insurance legislation. Agricultural insurance legislation is not usually intended to cover regulatory and supervisory issues, but rather to make statutory provision for a specific institutional framework (such as a statutory coinsurance pool or statutory reinsurance arrangements) and to govern the

provision of subsidy. In relation to subsidy, the legislation may obligate government to provide a certain level of subsidy, to take the subsidy outside the usual budgetary process, and/or establish a framework or arrangements to govern the use of the subsidy to ensure that it is not mis-channelled or used inefficiently. This could include establishing a body to make decisions relating to the subsidy, audit processes etc. Whether or not such legislation is required in Kenya will depend on the institutional framework that is eventually adopted and the level and types of subsidy that are to be provided for in the long term. It is therefore too soon to make recommendations in relation to this.

DRIVING THE PROCESS FOR CHANGE

Considerable work is required to build the necessary foundations for agricultural insurance, design and market appropriate products and establish an appropriate institutional framework. As discussed, this will require an effective PPP to be established. Without the active involvement of both the public and private sectors, it will not be possible to develop a mature, scaled-up agricultural insurance market in Kenya. However, it is unlikely that the process will even commence unless GoK takes the initiative and drives the process, encouraging insurers to engage and to collaborate, for example, through a coinsurance pool. This requires both financial and human resource commitments on the part of GoK

FUNCTIONS OF THE PRIVATE SECTOR

DATA

Private sector insurers play a primary role in the collection of some product specific data. Although the collection, management and audit of aggregate weather and agricultural data is primarily a public sector function, commercial insurers have functions in relation to the collection and storage of product specific data, such as data relating to sales, distribution and claims.

Data collection, auditing and / or management required both public and private sector engagement. International reinsurance companies will require a party other that government to be involved in either the collection or auditing of the data to ensure independence of these actions to ensure data is collected and audited in a transparent manner. Thus leaving the private sector a key role to play.

The private sector could also cover some / all of the cost of collection and management of agriculture data. It could be the case that an access fee is levied on all users who wish to use the data. This approach is adopted in Turkey for Motor Third Party Liability, where government is responsible for the collection and management of data. All insurance companies who wish to use this data to develop and price insurance products must paying an (equal) access fee. What is important here is that the data is equally available to all users on the same terms, to encourage competition.

As the design and rating of agricultural insurance products is also a private sector function, private sector insurers should play a role in advising GoK on their data needs i.e., (i) which data they require (ii) the form in which it is required; (iii) and the quality of the data.

The private sector can play a key role in developing and providing commercially available data. Data that is publically available at no charge or from commercial providers, such as satellite and remote sensing data, may be an acceptable substitute or proxy for data that is not available in Kenya (such as crop or weather data). For example, NDVI data is available from the National Oceanic and Atmospheric Administration of the USA. Where data in the public domain or available from commercial providers, will enable product design, it may be more efficient to use this data than to establish systems for the collection, management and storage of data in Kenya, even if the public sector contributes towards the cost of the data. The feasibility of using such data should form part of the "data gap analysis" recommended later in this Chapter.

OUTREACH

Outreach and product marketing is primarily a private sector function. As indicated, the public sector may have a role to play in raising financial literacy and general awareness concerning agricultural insurance, but outreach should be regarded as part of distribution, which is clearly a private sector function. Insurers sell insurance and, even if public sector agencies are used as part of the distribution process, this remains a private sector function. Furthermore, the private sector can (i) better employ innovative distribution channels (e.g. the Kilimo Salama scheme in Kenya uses mobile phones as a point of sales device); (ii) leverage the significant outreach infrastructure in place, and (iii) can respond quickly to shifts in the market. Most importantly, however, (iv) competition among private insurers can increase speed, scale, and the effectiveness of outreach.

DESIGN AND DEVELOPMENT OF AGRICULTURAL INSURANCE AND RELATED TASKS

Insurers are responsible for the design and development of agricultural insurance products, however there may be public sector support in the short-medium term. There may be a strong argument for the public sector providing financial and other support for the design and development of agricultural insurance products, particularly in the early years when the costs would be unsupportable through the premiums[9]. However, this remains a private sector function. Insurers are required through by the regulatory regime in Kenya and elsewhere to take full responsibility for the insurance products that they sell, including the actuarial pricing of those products.

Specialised professional and technical skills and experience are required to design, develop and price all insurance products, including agricultural insurance products. Where insurers do not have the resources in-house, they are permitted to use outsourced resources, which

[9] See the discussion above.

could include a publically funded body or unit, but insurers remain fully responsible for all outsourced services including those provided by or through the public sector. The institutional framework must be designed with this in mind.

Claims adjustment and settlement are also private sector functions. The comparative advantage of private insurers as opposed to the public sector is founded on (i) existing outreach channels; (ii) knowledge of the clients as they are responsible for distribution; (iii) a greater ability to innovate (for example, in India, cell-phone technology is used to video record, geo-tag and upload the results of CCEs in real time to a database, allowing insurance companies to access the data in real time. This mechanism both improved the quality (by enabling insurance companies to witness the CCE being carried out the video recording acts as an audit mechanism) and timeliness of the CCE procedure which greatly speeds up the process of AYII payouts); and (iv) the potential complexity of claims adjustment processes to which the private sector is better suited to respond.

Private insurers must have responsibility for the proper training of their insurance and distribution staff. Given the highly technical nature of insurance production, it is important that insurance staff have the required skillset to carry out their tasks. Thus, appropriate specialist training, in particular for agricultural insurance underwriters and loss adjusters should be undertaken. To ensure long-term sustainability of the approach and given the expertise of private insurers, this function should be taken on by the private sector. However, this is another area in which public financial and other support could be provided in the early years, particularly in relation to new and technical areas, such as index insurance.

RISK FINANCING

Underwriting agricultural insurance products and financing the risk is a core private sector function. Insurance business is the acceptance of insurance risk and the financing of that risk. Although the public sector may have some risk financing functions, as described, the function primarily belongs to private sector insurers. Insurers are required by the legal and regulatory framework, and the IRA, to take responsibility for the management and financing of their insurance risk.

Through pooling and diversifying their insurance risk, insurers are able to reduce the price of the risk, which should result in lower premiums to policyholders.

Insurers may reinsure their insurance risk with national, regional or international reinsurers as a substitute for holding capital to support that risk. The negotiation and conclusion of reinsurance contracts is part of their risk management process. Therefore, even where the public sector offers risk financing support, for example in relation to catastrophe risk, insurers must decide whether that support is adequate to enable them to underwrite the products.

1.3 INSTITUTIONAL FRAMEWORK

FIRST STEPS

ESTABLISHMENT OF A TASK FORCE

Although significant work has already been undertaken, further work is required before an institutional framework can be finalized and important policy decisions are required. For example, to what extent is GoK prepared to provide short-, medium- and long-term financial and other support to agricultural insurance. The considered views of stakeholders will need to be sought, including various GoK Departments and Agencies, Country Governments, the IRA and insurers. The design of a firm and final institutional framework at this stage would therefore be premature.

International experience demonstrates that, a PPP that is formalised in a well-designed institutional framework, agricultural insurance is more to succeed. International experience has also demonstrated that the establishment of the institutional framework is a necessary pre-condition for the design of specific agricultural insurance products. One of the reasons for the failure of many donor-funded pilots to scale up is the lack of institutions to follow through once the donors or development agencies have left. It is important, therefore, to give priority to the institutional framework even ahead of product design.

It is recommended that a Task Force is established to examine options for an institutional framework and that the Task Force should include representation from GoK and the private sector.

The duties of the Task Force should include consideration of:

- the appropriate functions of the public and private sectors;
- the options for an institutional framework, building on those presented in the MALF/GIZ Report;
- the institutional frameworks already operating in other countries and the experiences and lessons learned in those countries;
- the applicability of international experience in the Kenyan context;
- the legal and regulatory implications, including whether specific legislation or regulations will be required.

The work of the Task Force will provide contribute towards the formulation of a National Agricultural Insurance Policy, as recommended below.

NATIONAL AGRICULTURAL INSURANCE POLICY (NAIP)

The MALF / GIZ Report recommended that GoK expedite the policy process for the formulation and finalisation of a National Agricultural Insurance Policy (NAIP) as a guiding framework to develop the Kenyan agricultural insurance market. It was recommended in the Report that the NAIP should address:

- GoK's objectives for agricultural insurance including social objectives, for example preferential promotion and support programs for agricultural insurance for small and marginal farmers;
- Definition of the functions and roles and obligations of each party to the PPP;
- Establishing the institutions most suitable for delivering the functions identified by GoK to be implemented.

It is recommended that GoK should formulate the NAIP as a matter of priority. Once finalised, the NAIP will provide the blueprint for the institutional framework.

The formulation of the NAIP should be considered as a process rather than a discrete task that can be completed in the immediate future. It is therefore recommended that the work that is recommended to be undertaken by the Task Force should feed into the development of the NAIP, which should be regarded initially as a work in progress. As the work is undertaken, the NAIP would be adjusted accordingly.

INTERIM FRAMEWORK

Considerable work is required on product development. This is likely to include an analysis of the data required and available, the costs of designing agricultural insurance products, market demand, including the willingness and ability of potential policyholders to pay for the insurance, and the appetite of private sector insurers in Kenya and national, regional and international reinsurers to participate in agricultural insurance.

Consideration could be given to utilising existing institutions on an interim basis to commence the work. The functions could then be absorbed into the institutional framework, once finalised. For example, the MALF/GIZ Report recommended the formation of a national agricultural insurance web-based data and information iHub in order to link end users including agricultural risk managers, insurers, MALF staff etc, with the main institutions involved in agriculture and agricultural risk management and their existing databases. This will be needed whatever the institutional framework eventually established and could start work immediately.

In particular, the MALF/GIZ Report suggested that:

> *"the starting point for the iHUB project would be to define exactly what minimum (priority) key data is required for agricultural insurance purposes and to then check with ….. organisations what data and information they currently hold in their own databases, and the software formats of this data and time-series available and missing data. This would result in the production of a data and statistics catalogue covering the data held by each organisation."*

Defining the priority key data for agricultural insurance could be used to undertake a gap analysis, as recommended earlier in this Report. The detailed proposal is set out in the MALF / GIZ Report.

Given that this work is a foundation block for future product development, consideration could be given to establishing the iHub as soon as possible within an existing institution, such as MALF. The function, and work undertaken, could then be transferred to another institution, when the PPP is fully established (or remain with MALF).

COINSURANCE AND COINSURANCE POOLS

As it is unlikely that a fully competitive insurance market will be viable in Kenya, the Task Force should give consideration to establishing a coinsurance pool. This is due to the high costs of designing and distributing agricultural insurance to small farmers, and hence the need of some form of cooperation between insurers. Establishing a coinsurance pool would also enable the pooling of risk, which should result in lower insurance premiums.

There are many ways to structure a coinsurance pool, each with different features and advantages and disadvantages[10], with the core principles detailed in Box 2 below:

BOX 2: CORE PRINCIPLES FOR CO-INSURANCE POOL

Core principles for a coinsurance pool:

1. Insurers share the costs of certain core activities, such as product design and the pricing of products.
2. Certain administrative costs are shared, such as claims administration.
3. Other activities may be shared, depending on the pool design, including distribution costs.
4. There is at least some risk pooling. This may include presenting a pooled portfolio of insurance to reinsurers, enabling a lower reinsurance cost. Risk pooling should reduce the cost of risk, which would lower the cost of the premiums.

1.4 INSTITUTIONS

COORDINATING BODY

Given that public sector functions are spread between different GoK ministries, departments and bodies, it is important to ensure that public policy on agricultural insurance is effectively coordinated. The MALF/GIZ Report recommended that GoK consider the establishment of an Agricultural Risk Management Agency with the roles of

[10] Possible options for coinsurance pools are set out in Annex A.

coordinating public policy and providing support to the individual private sector companies that elect to sign up for the PPP. For an agricultural insurance PPP to be effective, it is important that GoK undertakes its functions effectively. The establishment of a separate entity, as recommended by the MALF/GIZ Report, would provide a mechanism for achieving this. It is suggested that the Task Force consider this, and other possible options for ensuring that the policy agenda is driven forward, and the PPP is implemented. If a separate entity is established, it will be important to ensure that the costs are kept to a minimum. This would require a small entity with a core staff of specialists.

Whether or not a separate entity is established, it is important that certain core functions are undertaken. These functions include: (i) coordinating the implementation of the PPP from a policy perspective; (ii) conducting original risk assessment and risk mapping studies on behalf of MALF; (iii) coordinating the implementation of the National Agricultural Insurance Policy (NAIP) with the private sector insurers; (iv) assisting private sector insurers in product marketing and education programs for farmers, including the allocation of subsidies; (v) providing of data and statistics and assistance in agricultural insurance product; (vi) conducting program research and development; and (vii) coordinating donor technical assistance programs for agricultural risk management and insurance in Kenya.

The institutional framework will need to cover monitoring, supervising, accounting for and auditing any public sector subsidy provided and advising on GoK on the size of the subsidy. The National Treasury (NT) will have a key interest in this function. The function could be housed within the coordinating unit or within the NT. The NT clearly has strong experience in public financial management, but it would be necessary to ensure that the MoF staff also has, or has access to, the technical capacity to undertake this function.

Given the high costs of technical tasks related to agriculture insurance, consideration should be given to establishing a Technical Support Unit (TSU) to house technical expertise centrally. As already discussed, technical functions belong to the private sector. However, given their costs, there is significant advantage for insurers to coordinate and centralise these and GoK may choose to support them. TSUs are typically present in countries in which there is some degree of competition between private insurance providers or distributers[11]. A TSU can have a wide range of responsibilities such as: (i) data analysis; (ii) insurance demand assessments; (iii) product design and rating, including basis risk analysis; (iv) design of operating systems and procedures; (v) training for stakeholders; (vii) awareness campaigns; (viii) analysis of any public subsidies; and (ix) the development of catastrophe risk models and other risk assessment tools.

However, the establishment of a TSU is not the only option. For example, if the private insurers went the route of a fully incorporated and capitalised and staffed pool insurance company the TSU is not required as it could be formed as part of the Managing Underwriting Unit of the Pool.

[11] Countries which have TSUs include Italy, France, Spain, Mexico, Chile, Brazil, Russia, Poland and Ghana.

2 LIVESTOCK INSURANCE FOR PASTORALISTS LOCATED IN ASALS IN NORTHERN KENYA

2.1 CONTEXT

KENYA'S EXPERIENCE WITH LIVESTOCK INSURANCE

Kenya has a lengthy history of livestock accident and mortality insurance for the commercial livestock dairy sector, but until recently the insurance market did not offer any cover to meet the risk transfer needs of the large numbers of resource poor pastoralists located in the arid and semi-arid lands (ASALs) of Northern Kenya. Following the devastating drought losses in the livestock sector between 2008 and 2011, which killed an estimated 9% of the national cattle herd with estimated livestock losses values at KShs , 699 billion (GOK 2012), government has signalled its major commitment under the second Mid-Term Plan 2013-17 to provide funding for a National Livestock Insurance Fund, NLIF, which would be implemented through SDL and NDMA.

Drought is the most pervasive hazard, natural or otherwise, encountered by pastoralist households in the ASAL regions and which can lead to widespread death of livestock due to starvation and related diseases and severe livestock asset depletion for the affected households. Many pastoralist households in the ASALs are now regularly hit by increasingly severe droughts. These households rely to greater extent on livestock, and high livestock deaths can have devastating effects, rendering many households amongst the most vulnerable in Kenya. The economic analysis presented in Section 2.4 shows that without any form of livestock insurance protection the poorest households (<5 TLU) and vulnerable Poor (<10 TLU) are very likely to lose all their livestock and therefore their livelihoods in severe drought events.

In order to address this growing challenge, the International Livestock Research Institute (ILRI), together with its technical partners at Cornell University and University of California Davis, first began to develop insurance solutions to help pastoralists manage drought risk leading to the death of their animals. Given the logistical challenges of working in the ASAL regions, it was decided to develop an Index Based Livestock Insurance (IBLI) product. The process involved two years of comprehensive research that was aimed at designing, developing and implementing market-mediated index-based insurance products, that livestock keeper – particularly in the drought prone arid and semi-arid lands (ASALs) – could purchase to protect themselves from drought-related asset losses. The IBLI product is based on a satellite NDVI[12]

[12] Normalised Difference Vegetative Index or NDVI which is a very good indicator of pasture growth and grazing quality and the impact of drought on pasture degradation over time.

cumulative-season drought index which is combined with a predicted livestock mortality index to insure pastoralists against catastrophe drought-related deaths to their livestock (cattle, camels, sheep and goats). The cover provides full value animal cover to enable the insured pastoralists to re-stock his/her herd after the drought event.

The commercial sale of Index Based Livestock Insurance (IBLI) was launched in Marsabit, Northern Kenya in January 2010 as a voluntary retail insurance product and marketed to individual pastoralists. The IBLI demand assessment studies identified affordability of the product by resource poor pastoralists as a constraint to uptake and therefore since launch in 2010 donor partners have financed premium subsidies in the order of 40% of the full premium costs. In 2010UAP Insurance Company was the underwriter while Equity Insurance Agency was the insurance agent. Swiss Re provided reinsurance for the product. The IBLI program has gone through various adjustments since it was launched, and APA Insurance Company became the underwriter for Marsabit and Isiolo counties in August 2012 and August 2013 respectively. In Wajir County, an Islamic compliant version of IBLI is currently being implemented by Takaful Insurance Company with support from Mercy Corps.

Whilst the current program has driven innovation in product development, pricing and distribution in the area of IBLI, several challenges remain most notable achieving large scale take of the insurance product. In 2010, the first year of launch of IBLI the program achieved considerable interest and uptake from pastoralists with a total of nearly 2,000 policy sales with about 6,000 insured TLUs[13] (ILRI 2013). Since then, however, the program has struggled to achieve scale-up and sustainability in spite of making payouts to insured pastoralists in response to droughts in 2011 and again in 2012.

GOVERNMENT OF KENYA-STATE DEPARTMENT OF LIVESTOCK INTEREST IN LARGE SCALE DROUGHT INSURANCE FOR PASTORALISTS IN ASAL REGIONS

As part of GOK's plans to promote and strengthen livestock insurance provision in the ASALs, under the Second Medium Term Plan (MTP II) 2013-17, the government has proposed the creation of a National Livestock Insurance Scheme (NLIS) with MALF and NDMA as the implementing agencies. An indicative budget of KSh 2,000 to 2,500 million over the fiscal years 2013/14 to 2017/18 was identified to support the NLIS[14].

With this objective in mind, in 2014 GOK through the State Department of Livestock (SDL), MALF approached the World Bank Disaster Risk Financing and Insurance

[13] Tropical Livestock Units, based on an adult cow being equivalent to 1 TLU, a camel is equal to 1.0 TLU and 10 goats are equivalent to 1 TLU

[14] Ministry of Devolution and Planning MDP 2013 (Second Medium Term Plan, 2013-17)

program's (DRFIP) AIDP, to provide technical support to develop a public private partnership (PPP) in livestock insurance to support pastoralists. The AIDP team partnered closely with ILRI and FSD Kenya to benefit from the considerable practical experience they have in Kenya, and to propose viable options to GoK for developing a livestock insurance PPP.

2.2 PROPOSALS FOR LARGE-SCALE LIVESTOCK INSURANCE FOR PASTORALISTS LOCATED IN ASALS IN NORTHERN KENYA

LIVESTOCK INSURANCE OPTIONS (SHORT AND MEDIUM TERM)

The proposal is to assist the State Department of Livestock (SDL) in collaboration with the National Drought Management Agency (NDMA), to develop a large-scale index-based livestock insurance program to cover pasture-drought risk, that over time will be made available to all pastoralists in the target ASAL Counties (detailed below). Due to the complex logistical requirements, issues of product development and challenges with basis risk of establishing such a program, it is proposed to implement a macro-level[15] product in the short term (calendar year 2015) that can be refined, developed and then complemented with a voluntary purchase individual product in the medium term (approx. after two to three years). During the interim phase, the possibility of offering the ILRI existing index-based livestock insurance product on a voluntary basis at the micro level shall be explored.

[15] The main distinguishing features between a micro-level individual pastoralist pasture/grazing-drought NDVI index insurance program and a macro-level program include: (1) under the micro-level program individual pastoralists purchase their own policy and they are the Insured for their declared number of animals (TLUs) while under the macro-level cover the Insured is government (or another appointed entity) which purchases a single policy of behalf of a defined target audience of pastoralist households who are termed the beneficiaries; (2) usually on a macro-level policy premium payments are fully covered by the Insured (government) and the beneficiaries do not contribute at all towards the costs of insurance premiums and (3) under the macro-level policy the beneficiary has no legal rights to make any claim against the policy as they are not deemed to be Insured.

<u>In the short term</u> it is proposed to assist SDL-NDMA to design and implement a macro level pasture-drought index insurance program that would be purchased by SDL on behalf of up to approximately 80,000 vulnerable pastoralists located in the 4 HSNP counties of Mandera, Marsabit, Turkana and Wajir, starting in 2015 or date tba. The SDL would insure itself at the national level, with insurance payouts triggered by a satellite-based index at a local / pastoralist level. The SDL would then channel payouts to pre-identified pastoralists on the triggering of the index. An element of cost sharing between Central and County governments shall be explored, with the initial proposal being the entire cost of the compulsory coverage paid by SDL.

The rationale for recommending start-up implementation of the SDL-Macro-Level large-scale pasture drought index insurance program in the four HSNP counties centres on the fact that infrastructure systems and procedures are already in place for (a) registering the eligible agro-pastoralists who will be the beneficiaries of this insurance cover and households) and (b) delivering timely insurance payouts in kind or in cash to the individual beneficiaries. In the HSNP counties, NDMA has assisted project management to conduct a major census exercise to register all 375,000 households and their dependents and to classify there households into four main income/wealth status categories or poverty bands. The HSNP program is currently targeting the poorest 100,000 households under its regular program of bimonthly cash payments and starting in 2014 plans to scale-up this program both vertically and horizontally in times of extreme drought. The proposal is to complement the HSNP program by implementing the SDL macro-level pasture-drought index insurance program with up to 80,000 of vulnerable pastoralists who are above the poverty criteria for inclusion in the HNSP program (See below for further discussion).

<u>In the medium-term</u> if there is sufficient voluntary demand by pastoralists for index insurance, it is proposed to offer as a complement to the macro level pasture drought index product, a top-up option for eligible pastoralists, plus voluntary policies which would be sold to all pastoralists on an individual basis. The macro level product as described above would be supplemented by the provision for the purchase of "top-up" insurance on a voluntary basis by pastoralists who benefit from the insurance, and the costs of any such "top-up" cover would be shared between GoK and pastoralists. This product would also be offered for voluntary, individual purchase by all pastoralists, independent of whether they are covered by the macro level product or not. The government subsidies for this top-up product would remain to be decided.

The proposed approach is phased over a number of years for the following key reasons:

(i) Establishing a system that provides for the distribution and servicing of individual insurance policies is logistically complex and can take time to establish. Thanks to the existing HSNP infrastructure (see section below); introducing only the macro level product will be less logistically challenging in the short term.

(ii) The interim time period will allow to test the product that will rely on a new asset protection approach (see section below). In particular, typical problems such as basis risk, consumer protection and product quality can be identified and addressed adequately before reaching out to a larger target group.

In 2015, it is proposed to complement the macro-level program by promoting the scale-up of the APA-Takaful Insurance Companies voluntary IBLI cover in the four HSNP counties. With the approach proposed above, to ensure all pastoralists in the target counties have access to purchase an index-based livestock insurance (IBLI) product, in 2015 SDL-NDMA could facilitate access to the established IBLI product designed by ILRI . Thus, all households who do not qualify for the government subsidized macro-level product would have the option to purchase the ILRI voluntary micro-level product. It is an asset replacement type product and is currently being sold in two of the four HSNP Counties (see below for further information). The AIDP team is currently working closely with ILRI on the feasibility of this approach and to analyse the implications.

INTEGRATING EXISTING SOCIAL PROTECTION AND INSURANCE PROGRAMS FOR PASTORALISTS IN THE TARGET COUNTIES

LINKAGES BETWEEN PROGRAMS IN THE ASAL REGION

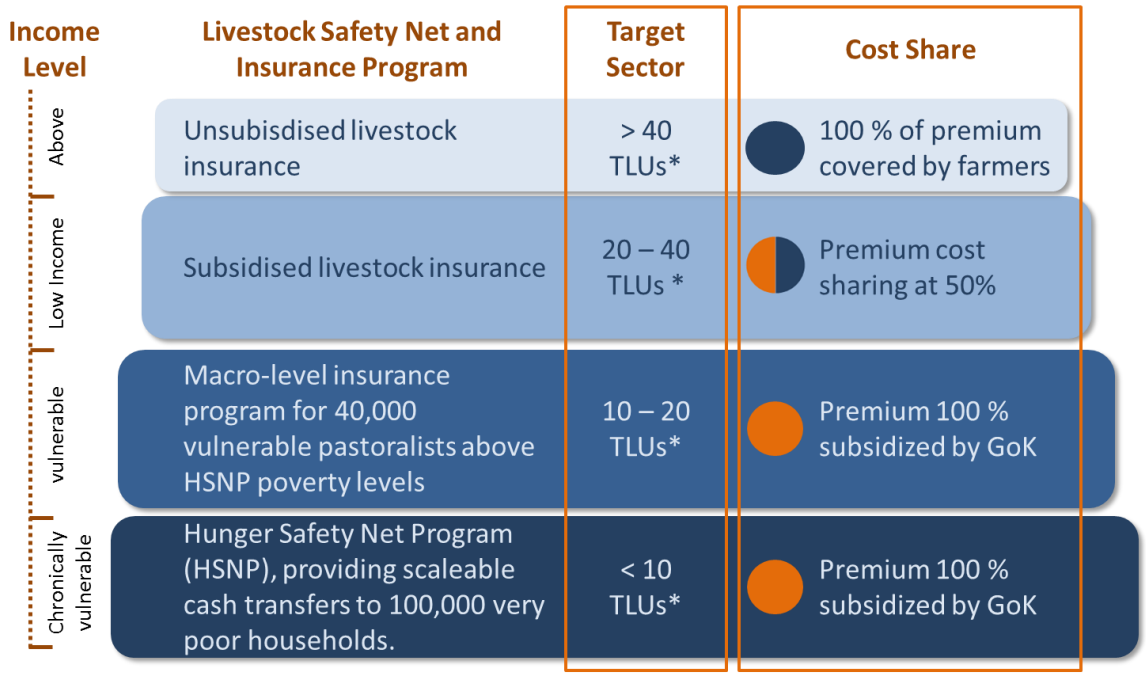
The overall framework for the insurance program should be mindful of the fact that there are various insurance products/social protection measures already being distributed or being currently developed in the four HSNP Counties. They include:

- The ILRI IBLI micro-level product (mentioned above);
- The HSNP protection;
- The new SDL-led IBLI macro-level initiative.

To avoid overlap between the three programs, it is proposed to use the HSNP classification of households according to wealth/poverty status and to target each insurance program to different poverty groups. The poorest 100,000 households would continue to be covered by the HSNP under the regular bi-monthly cash transfer program which is 100% financed by GOK and donors using a variety of funding mechanisms which starting in 2014 will include Africa Risk Capacity (ARC) index insurance payouts (see below for further discussion). Adopting the HSNP poverty ranking, the wholly government funded

macro level pasture drought index insurance program would apply to registered vulnerable pastoralists immediately above the HSNP's target beneficiaries. Finally, the ILRI designed, APA-Takaful insurance companies' voluntary individual pastoralist policy (or, in the medium term, the SDL voluntary index product) could cover wealthier pastoralists households. This layering approach is illustrated in **Figure 3**.

FIGURE 3:ILLUSTRATION OF HOW GOVERNMENT COULD SUPPORT FINANCIAL PROTECTION FOR DIFFERENT SEGMENTS OF THE POPULATION, USING THE EXAMPLE OF PASTORALISTS IN THE FOUR CURRENT HUNGER SAFETY NET PROGRAM COUNTIES (MANDERA, MARSABIT, TURKANA AND WAJIR)



Source: AIDP 2014

Notes. * Classification based on distribution livestock holding size for Marsabit County and which may not be similar in other HSNP Counties

In 2015 it is proposed to link the SDL macro-level product for the vulnerable category of pastoralists with ILRI's IBLI product would be sold on an individual basis to wealthier pastoralists in the four HSNP Counties. Whilst ensuring that all pastoralists will have an option to purchase livestock insurance (not just those covered by the SDL program), this will also allow the SDL and GOK to: (a) learn from the major technical design expertise and implementation experience gained under IBLI over the past 5 years, (b) offer choice to individual livestock producers who fall outside the poverty limits set by SDL for its program and (b) enable an assessment to be made over the next two to three years of the voluntary demand for livestock insurance by individual pastoralists in the

ASAL regions and on which basis (d) SDL can decide whether to introduce its own top-up and voluntary individual index-based livestock insurance products and programs, or not.

POSSIBLE LINKAGES WITH ARC

In 2014, Kenya and four other African Countries have signed up to a new African drought index insurance facility under the ARC initiative. The other countries that have joined ARC in the first phase include Mauritania, Mozambique, Niger and Senegal (ARC 2014). ARC represents an initiative by the Commission of the African Union's Department of Rural Economy and Agriculture (AUC) and the World Food Program, (WFP), to create a Pan-African owned Pool Index Insurance Fund to underwrite catastrophe weather events, initially to cover drought, but which in future would be expanded to include other weather risks such as flood[16] (ARC 2013). WFP estimates that a widespread catastrophe drought in sub-Saharan Africa could cost US$ 3 billion in emergency assistance. The program is insured by ARC Insurance Company Limited (ARC Ltd), domiciled in Bermuda and is reinsured by specialist international reinsurers of this class of business.

In 2014, it is understood that Kenya has purchased protection from the ARC, and that one of the primary purposes of the ARC program in Kenya will be to support the scalability mechanism of HSNP. Coverage has been purchased for both the Long Rains Long Dry season and a the Short Rains Season (max payout $30 million each) with a Risk Attachment Return Period (RP) of one in five years and an exhaustion Return Period of one in 50 years expected losses (ARC 2013). The primary use of the cover will be to lessen the fiscal burden to GOK of meeting the cost of scale up of the HSNP.

SDL could consider exploring the opportunity of potential linkages between the SDL macro insurance coverage to the ARC program in Kenya. Given the clear complementarities between these programs, this will be important to ensure that the synergies available are leveraged.

ELIGIBILITY AND SUBSIDY

The macro-level SDL product is intended to provide insurance to pastoralists who, at this stage, would not be able to afford commercial premiums. GOK therefore intends to provide a public subsidy for the product. Given the public subsidy, eligibility criteria will be required to ensure that targeting is in line with government objective to support the most vulnerable pastoralist households. As eligibility and subsidy both impact product design, decisions are required on these issues before the product design can be finalised.

[16]This initiative is being supported by the Rockefeller Foundation, DFID, The Global Fund for Disaster Reduction and Recovery (GFDRR) of the World Bank and IFAD

In principle, the macro-level program under which SDL would finance 100% of the insurance premiums targeted at poor and vulnerable pastoralist households (as defined by the HSNP database) who under other circumstances are too poor to afford insurance premiums. The final decision on eligibility will involve technical input from State Department of Livestock (SDL) and other Ministries. However, it is proposed that eligibility for the public subsidy is defined as *vulnerable* households that reside in the four pilot Counties, where vulnerable households are defined as a pre-defined number of households (TBD) ranked in the HSNP poverty census just above the eligibility cut-off point for benefits under the HSNP.

For the Macro-level index insurance program, it is proposed that GoK would purchase 100% of cover for five Tropical Livestock Units (TLU) per eligible household. The number of households covered will depend on the amount of resources the SDL has available to support the scheme. For illustrative purposes the team has chosen annual values of 100m, 200m and 300m KSH p.a. to analyse.

For top-up coverage for eligible households (in the medium term), the amount of subsidy shall be determined by the SDL. Initially it has been suggested that GoK would provide a subsidy for 50% of the actuarially calculated commercial premium, with the other 50% paid by pastoralists. This subsidy will be subject to a cap of 5 TLUs per pastoralist.

For voluntary purchased individual coverage, a decision from GoK is needed whether it will also be subsidized and what cap per pastoralist will apply. Over time, the GoK may plan to reduce the size of public subsidies. For the purposes of the Fiscal analysis presented in this report, a 25% premium subsidy has been applied (see Section 3.3).

SDL MACRO-LEVEL LIVESTOCK INDEX INSURANCE PRODUCT DESIGN OPTIONS

For implementation in calendar year 2015, a macro level livestock insurance product for the GoK-SDL is proposed: its central objective is to effect timely cash payouts to vulnerable pastoralists at the onset of drought in order to keep breeding stock alive. Under this scheme, the GoK would be the one entering the insurance contract. In case it receives a payout, in turn it would make payments to pastoralists as identified above.

For this macro level cover, satellite data (NDVI) would be used to create a pasture drought index. This would enable the development of an index that measures the onset of drought related pasture and grazing degradation and triggers early payouts to enable pastoralists to purchase animal feeds to keep their core breeding animals alive. The advantage of this approach in comparison to the existing ILRI product (interim period) is that payouts could be triggered earlier in the season, i.e. during the onset of drought. At that time, reduced pasture/grazing has not yet become a disaster and

pastoralists are neither forced into untimely sales of livestock at very reduced prices nor have animals starving or prone to disease and ultimately death. Thus, this product would enable pastoralists to use the funds provided to preserve livestock (through buying fodder, migrating, culling etc.) rather than having to replace it.

Similar approaches have, for example, been implemented in the following countries:

- **Spain, USA and Canada:** In these countries the NDVI pasture drought index insurance programs operate as voluntary micro-level individual livestock producer programs. The cover period is defined as the normal pasture/grazing growing season (which usually coincides with the spring and summer rainy seasons of maximum pasture and biomass production) and the basis of the sum insured is usually calculated according to the nutritional requirements of the livestock/costs of purchasing supplementary livestock feeds in the event of loss of pasture and grazing due to drought. Regular payouts are made during the cover period for each month (or time period as defined) that the NDVI policy is triggered. All three programs attract heavy government premium subsidy support.

- **Mexico**: The federal and state governments purchase macro-level NDVI/pasture drought cover used to finance payouts in the events of catastrophic losses in pasture and grazing to the large numbers of small vulnerable livestock producers (owning <60 livestock units) and who are eligible for state funded natural disaster assistance under the CADENA program. 100% of the premium cover is borne by federal and state governments together (80:20 ratio). Since introduction of the program in 2006, it has been massively scaled up such that in 2011, a total of almost 60 million hectares of grazing lands were insured in 21 states and nearly 4 million head of livestock were protected.

- **Uruguay and Argentina**: From 2011-2013, the World Bank has assisted the Government of Uruguay (GoU) and the Government of Argentina (GoA) to design NDVI/pasture-drought macro-level products protecting livestock and issuing early payouts.

The SDL-Kenya macro-level NDVI product is currently under development and a prototype contract has been designed and which will be presented to key stakeholders including SDL and livestock producer associations in the ASAL regions in order to be reviewed, refined and finalised. The product draws on the lessons and experience of the Mexican, Argentinean and Uruguayan livestock NDVI programs, while taking the local Kenyan context into account. A comparison of the Uruguay macro-level NDVI cover and the proposed macro-level cover for SDL in Kenya is presented in Figure 4.

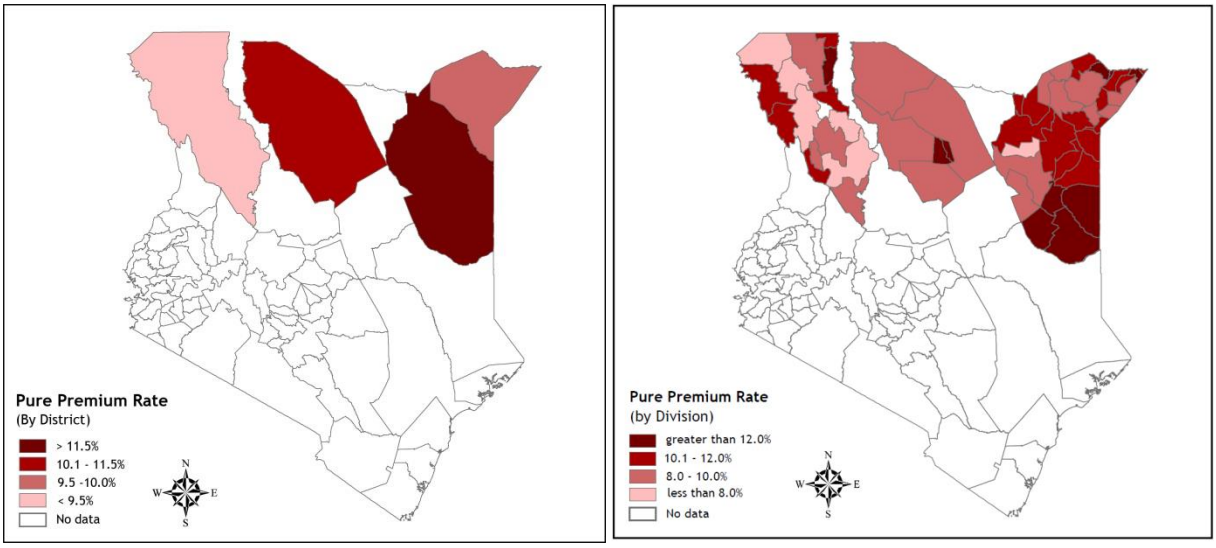
FIGURE 4: COMPARISON OF URUGUAY PASTURE NDVI COVER AND PROPOSED KENYA NDVI COVER

Product Feature	Approach taken in Uruguay	Considerations for Kenya
Index	– NDVI/pasture index – 5x5 km (2,500 ha)	The required index and data will be based on the existing NDVI database created and maintained by ILRI: – NDVI/pasture index – 250mx250m (eMODIS)
Cover Period	– Pasture growing season: 7 months (September – March)	- This is still being explored. Northern Kenya has two rainy seasons (Long rains (March - May) and Short rains (Oct - Dec); ideally both would be covered.
Insured Unit	- Police Section (equivalent to a municipality) areas because homogeneous NDVI signature and individual livestock herd data is registered at this administrative level for FMD control purposes	- This is still being explored. Preliminary discussions with ILRI indicate that index products could be more effective at a smaller scale than the Division level.
Insured Interest	- Beef cattle (breeding cows and heifers only). Program has been designed to cover all registered Beef cattle herds in Uruguay	- All households in the HSNP poverty census above the cut-off point for the regular program
Sum Insured	- Based on nutritional requirements of insured cattle during the insurance cover period, assuming animals are fed on supplementary feed rations that can be purchased locally.	- This is still being explored. For example, more input is being collected from livestock experts on nutritional requirements, etc.
Payout Parameters	- Monthly payout frequency because once pasture degradation is visible on NDVI, the insured cattle are already suffering from starvation - Sum paid out along gradual trigger with entry and exit point	- Different payout frequencies being explored (monthly, 3-months, seasonal basis) and have to be determined based on pastoralists' needs - Gradual and Binary trigger options being explored, i.e. paying out either in full or not at all, for simplicity

An example of the outputs of the macro-level prototype NDVI pasture drought index insurance cover is illustrated in Figure 5 which shows the calculated pure loss costs (average expected payouts) at district and divisional level for an annual 12 month

policy for the 4 HSNP Counties. The calculated pure premium rates are presented for the 4 HSNP counties (and their divisions), Turkana, Marsabit, Wajir and Mandera and in general terms reflect the increasing drought risk exposure in natural rangelands from west to east as measured by Modis NDVI by month for the 13-year period 2001 to 2013. Decisions that will need to be taken with local stakeholders in due course include the size of Insured Unit (County or Division) and whether to market top-up or voluntary cover using differential premium rates in each insured unit.

FIGURE 5: ILLUSTRATIVE CALCULATED PURE LOSS COST RATES FOR 12 MONTH NDVI ASSET PROTECTION COVER AT DISTRICT & DIVISION LEVEL



Source: AIDP 2014.

Notes: Assumptions: 12 month coverage with equal coverage in each month (8.3% of annual TSI) with trigger set at ZNDVI (-0.5) in a given month for payouts to begin, with exit at ZNDVI (-1.1) where the maximum payout is (8.3% of TSI for that month)

In order to determine with the proposed macro-level NDVI-pasture drought degradation cover with its emphasis on early payouts to keep breeding animals alive is appropriate to the pastoralist production systems of Kenya's ASAL's further research will be required into the following key areas:

- **Focus Groups Discussions (FGDs)** with pastoralists in the target HSNP Counties to understand better how early drought index insurance payouts could be used to support the protection of their breeding herds (buying in fodder and animal feed supplements, migrating/transporting animals to other grazing lands, controlled destocking of animals etc)

- **The most appropriate definition of the Insured Unit:** Department, Division or a smaller area with homogeneous grazing/rangeland conditions and which is effected in a similar way by drought. Here it will be important to take into account the seasonal migration patterns of the pastoralists as they move their non-breeding herds to their dry season grazing lands and which may be outside the defined Insured Geographic Unit where they normally reside. If the Insured Unit is set at a very small localised level, this may invalidate the operation of such an NDVI cover.
- **How to integrate any macro-index insurance program with NDMA and SDL drought response plans for the livestock sector** including controlled destocking programs, livestock watering, pasture and grazing conservation measures, government emergency livestock feed programs (if these currently exist), veterinary support programs during times of drought etc. A key point to note that under a macro-level index insurance program aimed at keeping animals alive, it will be important to avoid sending out the wrong message to pastoralists that they do not need to implement destocking to reduced over-grazing in times of acute drought as they will receive insurance payouts.
- **Analysis of the presence or otherwise of local public or private forage markets in times of drought in the ASALs.** These markets are essential, and could be: (i) a GOK-SDL fodder supply program in place at the onset of drought and / or; (ii private traders can be incentivised to truck fodder from surplus regions of Kenya to the drought stricken regions.

REGISTRATION AND DISTRIBUTION CHANNELS

SDL MACRO LEVEL NDVI PROGRAM

Registration could be done automatically through the existing HSNP database. This would be cost effective and less time consuming. However, the automatic registration could present some complications, notable: (i) lack of explanation of the product to beneficiaries could lead to poor awareness of the benefits being provided and claims procedures; (ii) low programme awareness in the region, reducing political visibility and broader awareness of the product; (iii) limited expansion of insurance awareness, loosing potential financial inclusion gains; (iv) confirmation of beneficiaries inclusion in the program would be hard, and; (v) beneficiaries may never understand the benefit being provided to them by GoK.

Thus, it is proposed that: (i) initial registration for households eligible for GoK subsidy would not be automatic, but would need to be completed in person; (ii) it is recommended that the private sector are used for registration for insurance, given they were used for HSNP registration.

A potential option could be to enrol pastoralists into the insurance program when they collect their bank cards. All pastoralists registered under the HSNP poverty census

will have a bank account and a bank card by December 2014. At that time, an explanation could be provided of the programme benefits, payments procedures, issuance of cards and pins, confirmation of persons and identification details, awareness/education and consumer protection issues.

Although more time time-consuming and costly, this method will support the development of a sustainable market. It has the key benefit of ensuring eligible households understand the insurance coverage they are being given, and further; understand the details of how the insurance product operates (how the triggers are based on satellite data, what the trigger points for payout are, etc.). These measures will be key in order to promote the voluntary purchase market. In addition, this will encourage voluntary take up through spreading awareness of the insurance product.

Ultimately, this will be a private sector led process; however there may be need for GoK support in the short term. It is recommended to have a private sector led initiative which given the primary motivation would be demonstration of viable long-term business opportunities, would be more sustainable. This would, in the long run, provide an opportunity for expanding more financial opportunities to the target communities as well as lowering the overall cost of execution compared to the government led initiative. The private sector led process would undertake fresh registration of beneficiaries, develop and manage payment infrastructure under contractual arrangement with the government. The tendering process would be used to select the provider(s) or consortium to offer registration and/or distribution processes.

TOP-UP AND VOLUNTARY PURCHASE PRODUCTS IN THE MEDIUM TERM

There will be significant distribution challenges beyond the subsidised cover, particularly as insurance will not be linked to credit. The challenges would emanate from potentially high operational costs associated with the sales and service process and to date have been significant in Northern Kenya. The distribution should primarily be the responsibility of the private sector. The top up could potentially happen at the registration process where beneficiaries of the government supported programme could opt for additional coverage. This could potentially utilise the proposed distribution channels or the underwriter could be able to come up with a cost-effective model for distribution of this additional cover. Voluntary purchase could be done through developed or parallel network and infrastructure.

LEGAL AND REGULATORY ISSUES AND THE ROLE OF INSURERS

It is necessary to consider both legal issues and regulatory issues (beyond consumer protection) during product design. It is also important to consider the role of insurers and insurance intermediaries. However, ultimately, the regulatory framework is a matter for the IRA, which should be kept informed as the product is designed.

The IRA is currently regulating and supervising the insurance sector under the current Insurance Act. However, a new principles-based Insurance Act is under consideration. If the new Act is enacted, it will enable the IRA to develop Regulations, which will foster an enabling environment for livestock insurance.

CONTRACT DESIGN (MACRO LEVEL POLICY)

For the proposed SDL-MALF macro level NDVI pasture drought index insurance policy, the insurance contract will be purchased by GoK-SDL, not by individual pastoralists. It is recommended that the policy would be set up as a macro level policy, purchased by GoK, for the benefit of eligible pastoralists. Payment would be made either to GoK (who ultimately pay to covered pastoralists) or directly to the pastoralists. A point to note here is that a beneficiary does not have an automatic right to enforce a master policy against the insurer, which is recommendable as it makes the program much easier to implement. Enforcement rights are dependent on the terms of the policy.

CONTRACT DESIGN (VOLUNTARY PURCHASE PRODUCT)

In the medium term, the voluntary purchase product will be made available both to pastoralists benefiting from the macro level product as a voluntary top up and to all pastoralists as a freely purchasable insurance product. For the pastoralists to whom it is a top up to the macro product, it would be preferable for the top up to operate as an extension to the macro level policy. It would thus become an extension of the same "Master" policy. This would be by far the most straightforward approach.

For all other pastoralists, the freely purchased insurance policy would be more difficult to fit within the constraints of a "Master Policy". However, issuing a series of individual policies would add to the transaction cost. Under this scenario, consideration should be given to allowing pastoralists to enforce the policy against the insurer. There are possible cost implications in providing pastoralists with the right to enforce as the insurer may have to deal with pastoralists who may seek payment on the basis of losses, even though the index has not triggered, and this would need to be factored into the premium as an additional risk (which would be very difficult to cost).

FORM OF CONTRACT

Even though eligible pastoralists will not contribute to the premium payable under the macro-level policy issues to SDL-MALF, it is important to keep the insurance contract/policy as straightforward as possible. There are a number of reasons for this:

- The contract/policy design will most likely become a precedent;
- Eligible pastoralists will be paying for the voluntary top up (in the medium term); and
- A similar contract form should be used for the master policy and for the individual policies (in the medium term).

Other issues to consider will be the potential use of electronic policy acceptance. This is not an issue directly covered under the current legal and regulatory framework, although there is precedent for it in relation to other products.

ROLE OF PRIVATE SECTOR INSURERS

As a PPP is envisaged, it is critical that the private sector insurers are engaged at an early stage as the PPP will not be able to work effectively without their willing participation.

In the short term, there would be a single macro level policy, the policyholder being SDL-MALF. Under the Kenyan Insurance Act, insurance must be purchased through the local market unless there is insufficient capacity.

The policy would therefore need to be purchased from a local insurer or insurers. If reinsured, after any compulsory cessions to national/regional reinsurers, the balance could be placed into the international market. There is, therefore, no legal option for GoK to purchase directly from the international market. This would almost certainly add some transaction cost.

In the medium term, there would be a single master policy plus a series of individual policies. Both the master policy and the individual policies would need to be purchased from a local insurer or insurers.

2.3 FISCAL COSTING ASSUMPTIONS AND SCENARIOS

The assumptions underlying the estimation of the potential fiscal costs of the programs described above are the following.

The macro-level NDVI-based index insurance product for livestock asset protection will target the poor "vulnerable pastoralist" that are above the poorest 100,000 beneficiaries of the HSNP program. The program will be implemented in the four counties covered by HSNP (Mandera, Marsabit, Turkana and Wajir) and is expected to cover free of charge between 80,000 and 100,000 pastoralists.

The optional "Top-Up" coverage for pastoralists enrolled in the program will be made available in year 3 of implementation. In addition, pastoralists that have not been part of the initial target group will also have the option to purchase on a voluntary basis the NDVI-based insurance coverage. The first layers of both the Top-Up option and of the coverage for Non-Target group pastoralists will be partially subsidized. The relationship of the SDL macro-level automatic NDVI livestock insurance and voluntary top-up cover at year 3 with the HSNP cash transfer program is illustrated in **Figure 6**.

FIGURE 6: RELATIONSHIP BETWEEN SDL MACRO LEVEL LIVESTOCK INSURANCE PROGRAM AND TOP-UP COVER AND VOLUNTARY SALES AND HSNP CASH TRANSFER PROGRAM

HSNP Poverty ranking by Income level	Livelihood classification (or Poverty bands)	Safety Net /Insurance Program	Number of Tropical Livestock Units (TLUs) insured by program	Level of support
Above	All pastoralists above 10 TLUs	Individual Livestock Insurance (at year 3 of index insurance program)	Unlimited	Premium entirely covered by pastoralists
Low Income	Pastoralists above previous poverty level bands	SDL Subsidised Voluntary Individual Livestock Insurance (at year 3 of index insurance program)	Up to 10 TLUs	Premium 25% subsidised by GoK
Vulnerable	80,000 - 100,000 vulnerable pastoralists above HSNP poverty level	SDL Subsidised Voluntary Individual Livestock Top-Up Insurance (at year 3 of index insurance program)	5 to 10 TLUs	Premium 50% subsidised by GoK
		SDL Macro level index insurance	Up 5 TLUs	Premium 100% subsidised by GoK
Chronically Vulnerable	HSNP, 100,000 Very poor	Direct Cash transfers	----	100% supported by GOK possibly through ARC Drought Index Insurance Payouts.

Source: AIDP 2014

ESTIMATED FINANCIAL COSTS OF THE MACRO-LEVEL LIVESTOCK NDVI PROGRAM

For the macro-level asset protection scheme, following specific indications of SDL, three public support scenarios of, respectively, KShs 100 million, KShs 200 million and KShs 300 million are analyzed. The projected fiscal costs of the programs are summarized in Table 2 and Table 3. For each budget scenario, two extreme cases are presented. CASE A is structured by selecting, within a reasonable range of variation, the more costly extremes of the key parameters (i.e., higher values per TLU insured, a higher number of TLU per policy and a higher insurance premium estimate). This defines a lower bound for the number of potential pastoralist to be covered with the reference budget available. On the other extreme, CASE B takes into account the less expensive options, thus identifying the higher bound for potential pastoralist to be covered.

Depending on the policy choices to be made, and on the parameters that will be selected, a budgetary support from KShs 100 million to KShs 300 million would

provide coverage to a range of approximately 16,000 to 165,000 pastoralists. In particular, a budget of KShs 100 million would cover from 16,000 to 50,000 pastoralist, a budget of KShs 200 million from 35,000 to 110,000 pastoralists, and a budget of KShs 300 million from 50,000 to 165,000 pastoralists.

The analysis shows that, in order to cover a reference target group of 80,000 to 100,000 pastoralists under the macro-level insurance option whereby SDL would be the insured and responsible for payment of premium, the required fiscal resources to be made available would be in the range of KShs 200,000 (US $ 2.3 million) or above.

TABLE 2: (REDUCED VERSION): FISCAL COSTING PROJECTIONS FOR MACRO-LEVEL ASSET PROTECTION COVERAGE

	SCENARIO KSh 100 million (US $ 1.2 million)		SCENARIO KSh 200 million (US $ 2.3 million)		SCENARIO KSh 300 million (US $ 3.5 million)	
	Case A	Case B	Case A	Case B	Case A	Case B
Budget available for Macro-level asset protection coverage - KSh	*100,000,000*	*100,000,000*	*200,000,000*	*200,000,000*	*300,000,000*	*300,000,000*
No of pastoralists eligble for livestock asset protection coverage	*16,637*	*53,107*	*34,159*	*109,040*	*51,681*	*164,972*

ESTIMATED FISCAL COSTS OF THE TOP UP AND VOLUNTARY LIVESTOCK INSURANCE PROGRAMS

At year 3 of the program (i.e., in 2017), a partially subsidized Top-Up option for covering an additional 5 TLUs will be offered with a budget requirement ranging from roughly KShs 2 million in 2017 to KShs 15 million in 2021. This scenario is estimated assuming a progression in 5 years from 1,000 to 10,000 pastoralists that will voluntarily purchase the coverage, together with a public support of 50% of the premium cost.

Together with the Top-Up option, from year 3 all Non-Target pastoralists will be allowed to purchase the NDVI asset protection coverage with a support of 25% for up to 10 TLUs insured, generating an additional budget requirement of KShs 5 million to KShs 16 million between 2017 and 2021. This projection is developed by assuming that in the 5 years interval 1,000 to 5,000 Non-Target pastoralists will purchase the coverage.

The two additional insurance schemes to be implemented at year 3 of the program could in aggregate increase the budget requirements by roughly KShs 6 million in 2017 and KShs 31 million in 2021.

TABLE 3: (REDUCED VERSION): FISCAL COSTING PROJECTIONS FOR TOP-UP AND NON-TARGET PASTORALISTS OPTIONS

	2017	2018	2019	2020	2021
Cost of public support for TOP-UP option (million KSh)	1.6	5.1	8.6	12.1	15.6
Cost of public support for NON-TARGET pastoralists (million KSh)	4.7	8.6	11.7	14.1	15.6
Total cost for GoK (million KSh)	***6.3***	***13.7***	***20.3***	***26.2***	***31.3***
Total cost for GoK (million USD at 85 KSh/USD)	***0.1***	***0.2***	***0.2***	***0.3***	***0.4***

In summary, the estimated fiscal costs for the combination of a) the macro-level asset protection coverage, b) the Top-Up option, and c) the expansion to Non-target group pastoralist is estimated at around KShs 210 million at program inception and at around KShs 230 million when the programs have reached the projected scale.

In the next steps SDL-MALF and other key stakeholders will need to consider funding arrangements to cover the costs of premiums and other design and implementation costs for the macro-level NDVI insurance program and also the voluntary top-up programs which carry premium subsidies. One option would be to use the proposed National Livestock Insurance Fund to finance the premiums and other program costs including registration of beneficiaries, education and training programs, program design and implementation and auditing costs.

2.4 WELFARE IMPACTS OF INDEX-BASED LIVESTOCK INSURANCE IN HSNP COUNTIES

The four HSNP counties are among the poorest counties in Kenya, with the majority of the population depending heavily on livestock both for income and food. The ultra-poverty rate[17] in 2012 estimated by HSNP household survey is at 46.8% with the average consumption expenditure per capita per month of 1,746 KShs. The share of livestock income in total household economic income ranges from 25%-80%, and the share is larger for the poorer quintiles. Livestock production is the key source of livelihood in this region. Alternative productive livelihood appears very limited, and is only accessible to the wealthiest. Among other alternative livelihoods for the poor majority are petty trading, casual labour and small cropping.

Livestock holdings provide offer a good proxy for welfare in this region, with the poor owning small herds but relying more heavily on livestock. From longitudinal monthly household survey by Arid Land Resource Management Project (ALRMP) in these counties, average herd size owned by households is at 10.4 TLU during 1999-2013. On average, households in the two poorest quintiles own less than 5 TLU, those in quintile 3, 4 and 5 owns between 5-10 TLU, 11-20 and more than 20 TLU accordingly. Livestock

[17] Based on national rural poverty line – Equivalent to $0.5/day

production system could vary across and within the four counties with relatively larger mobile pastoralists (and so herd size) in the relatively low and arid lands of northern Marsabit, Mandera and Wajir.

Livestock production in this region is prone to droughts that can cause catastrophic herd losses. Extreme droughts have occurred 4 times over the past 10 years. Average livestock mortality rates from 1999-2013 ALRMP data ranges from 9-18% per year. Because households rely extensively on livestock, widespread livestock mortality has directly led to increasing poverty and food insecurity in the region. Over time, the recurrent droughts have caused an increase in poverty and decline in average herd size owned by households.

Households in this region rely heavily on food aid, risk-sharing within communities and other emergency response and welfare programs to cope with droughts, but they are largely uninsured. One of the key government programs that provides support is the HSNP's regular cash transfer program of approximately 3,500 KShs per two months per household. HSNP impact evaluation results find that the cash transfer has reduced poverty as well as having been used as safety net during drought 2011 in the region. Other coping mechanisms also appear very limited leaving households uninsured against catastrophic herd losses from droughts. For example, households are largely credit constrained with limited access to financial services.

We have conducted a detailed economic analysis of the likely impact of livestock insurance on four categories of pastoralist: poorest, ultra poor, poor, and non-poor. We develop a dynamic model to explore the potential varying welfare impacts on a representative pastoral household in each of the four wealth groups: the poorest with small herd, the ultra-poor with vulnerable herd, the poor with medium herd and the non-poor with large herd (see Annex B.3. Summary of modeling and simulations of welfare analysis for Livestock for detail on modelling and simulation). In the economic model each season, a household earns income from milk production and livestock offtake, of which they then choose to consume and accumulate herd for the next season. Each season, own herd grows in normal years but may fall due to livestock mortality, which could be due to various idiosyncratic factors, e.g., disease, sickness, accidents, etc., as well as the covariate catastrophic droughts.

The analysis considers the likely impact of 'asset protection livestock insurance'. For the asset protection product, similar design features to the IBLI asset replacement contract designed by ILRI were assumed, however with payouts being made earlier as opposed to the end of the season. The analysis assumes that monthly insurance payouts could allow effective early interventions which enable the insured pastoralist to keep insured livestock

alive. Sensitivity analysis was also performed with varying assumptions, and the key results did not vary significantly from our main assumption. Our analysis considers both short-term and long-term impacts of this livestock insurance along with the proposed forms of government supports on the four distinct subsets of the population.

Catastrophic herd losses from droughts could have immediate welfare effect by reducing livestock income available for consumption. While severe droughts can immediately push the better-off poor, and non-poor into poverty, they could severely push the ultra-poor and the poorest with extremely low livestock income into destitution. The black lines in Figure 7 depict these impacts. 1-in-4 year droughts could push livestock income of the poorest (whose consumption relies extensively on livestock) to the level of destitution (13 KShs /day/capita). A 1-in-8 year drought might also push income of the relatively better off households with medium herd size below the food poverty line and could bring the non-poor households into poverty.

We find that free provision of asset protection livestock insurance could reduce vulnerability but would not likely provide immediate exit from poverty. The long-dash red lines depict these patterns. This is contrastable to the existing HSNP cash transfer program in the region, where approximately 3,500 KShs have been transferred to the poorest eligible households every two months. As the green lines depict, direct cash transfer could potentially produce immediate poverty reduction effects for some groups, e.g., the ultra-poor whose have been boosted up above the food poverty line in some good years.

By itself, direct cash transfers could still leave poor beneficiaries vulnerable to falling into poverty in extreme years. Complementing cash transfer with the free provision of livestock insurance might provide a more sustainable exit from poverty. Especially for the ultra-poor, the long-dash and dash green lines show that asset protection livestock insurance coverage could offer immediate protection of the cash transfer beneficiaries from falling into poverty in 1-in-6 year extreme droughts. This is the intention of the current plans of scaling up and out of the HSNP.

The biggest impacts of livestock insurance are expected to be realized in the longer term, whereby livestock insurance could help pastoralists to build up the herds over time and protect the herd from falling below the viable size necessary to avoid collapsing into poverty trap. Existing academic research (Lybbert et al. 2004, Barrett et al. 2008, Santos and Barrett 2013, Chantarat et al 2014, among others) identify the existence of a critical herd size of about 10-15 TLU (see Annex B.3. Summary of modeling and simulations of welfare analysis for Livestock) that will be necessary to sustain a viable herd accumulation in this region. With limited productive non-livestock livelihood options and

the need for seasonal migration as adaptation to climate variability, pastoral households in this region consume a good portion out of their own herd each season (e.g., through direct slaughtering or off-taking for cash). This necessary consumption out of own herd each season tends to slow down and disrupt natural herd growth especially for very small herd. Households with small herd sizes (below the critical threshold) thus tend to deplete their herds over time. Furthermore as poor households tend to be to credit constrained, this prevents them from being able to restock their herds up to the economically viable and sustainable levels. They tend to be trapped in small, collapsing herd size and low consumption – the poverty trap researchers found in this vulnerable pastoral region.

The biggest impacts of livestock insurance are expected to be realized in the longer term, whereby livestock insurance could help pastoralists to build up the herds over time and protect the herd from falling below the viable size necessary to avoid collapsing into poverty trap. Existing academic research (Lybbert et al. 2004, Barrett et al. 2008, Santos and Barrett 2013, Chantarat et al 2014, among others) identify the existence of a critical herd size of about 10-15 TLU (see Annex B.3. Summary of modeling and simulations of welfare analysis for Livestock) that will be necessary to sustain a viable herd accumulation in this region. With limited productive non-livestock livelihood options and the need for seasonal migration as adaptation to climate variability, pastoral households in this region consume a good portion out of their own herd each season (e.g., through direct slaughtering or off-taking for cash). This necessary consumption out of own herd each season tends to slow down and disrupt natural herd growth especially for very small herd. Households with small herd sizes (below the critical threshold) thus tend to deplete their herds over time. Furthermore as poor households tend to be to credit constrained, this prevents them from being able to restock their herds up to the economically viable and sustainable levels. They tend to be trapped in small herd size and low consumption – the poverty trap researchers found in this vulnerable pastoral region.

The existence of a viable herd threshold size could imply that catastrophic herd loss from drought could be irreversible especially when droughts have led to livestock losses below the viable level. Figure 8 provides example of common herd accumulation over time for different herd groups. It shows that especially for poor households with vulnerable herd size around the viable threshold, a big 1-in 6-year herd loss could push herd size down to the level that will not be recovered without other restocking intervention. For the poorest with small herd, extreme droughts could stimulate the speed of herd collapse toward destitution. For large herd, droughts could disrupt and slow down herd accumulation over time. Overall, as the potential impacts of droughts could vary across different herd groups, so would be the potential impacts of livestock insurance and related government support.

Livestock asset protection insurance that is designed to keep the core breeding stock alive during severe droughts could have large long-term impacts especially on poor households with vulnerable herds when the scheme could effectively protect them from falling into a poverty trap. From Figure 8, free asset protection insurance and the top up coverage might provide enough cash for effective early intervention and allow households to save and grow their viable herd, which otherwise could collapse. The overall impacts could be large when insurance coverage is offered with cash transfer that can also relax the required consumption out of own herd. From our simulation exercise with large numbers of replicated years, Figure 9 further depicts the expected probability of falling into the poverty trap (losing viable herd) 5 years after being hit by extreme drought-induced livestock losses at different magnitudes. It appears that free insurance and 50% subsidized top up coverage could reduce up to 60% probability of falling into poverty trap. And if these schemes were to be combined with cash transfer, altogether they could reduce up to 80% probability. This is in contrast to the sole cash transfer program, which could offer temporally poverty reduction while still leaving beneficiaries vulnerable to falling back into poverty in extreme drought years.

For better off households with medium and larger herds, livestock insurance could help them grow their herds over time by stabilizing their herd accumulation. So unlike a typical insurance where insured might need to sacrifice average income for insurance protection (as they pay for high premium for coverage that will only reduce variability but not increase productivity), livestock insurance could crowd in productivity improvement effect through more stabilized herd accumulation. From Figure 8, it appears that commercial asset protection insurance could be attractive to this group given that it could be less costly for insurance to disburse early payout to keep livestock alive than to replace lost livestock and that there could be multiplier effects from protecting critical breeding herd through herd accumulation.

Livestock insurance might have the smallest long-term welfare effects on the poorest with small and non-viable herds as by itself livestock insurance is unlikely to help them to reach a viable herd size. Figure 8 and Figure 9 also show that while combining direct cash transfer with free livestock insurance might help stabilize herd and slow down herd collapse in the short run (e.g., as cash transfer could potentially relieve necessary consumption out of owned herd), the scheme might not alter sure probability of falling into poverty trap for this small herd group.

Overall, these varying insurance impacts thus naturally result in appropriate targeting strategies of public support to livestock insurance. Supports targeted to ensure effective safety net among the vulnerable group could be very cost effective in reducing poverty in the long run. As we see poverty increases (and herd declines) in this

region overtime due to recurring droughts. Safety net intervention that can keep the vulnerable households from joining the rank of the poor will allow government to concentrate their limited resources to bringing existing poor out of poverty. For the poorest, a combination of cash transfer and an effective insurance could work to reduce vulnerability (and immediate poverty). But if the goal is to move the poorest households with small herds out of poverty in the long-run through pastoral production, complementing livestock insurance with interventions that promote restocking toward a viable herd could be critical. For the larger herd groups, promotion uptakes of the (potentially cost effective) commercial livestock could be effective.

FIGURE 7: POTENTIAL SHORT-TERM IMPACTS OF LIVESTOCK INSURANCE ON INCOME AVAILABLE FOR CONSUMPTION

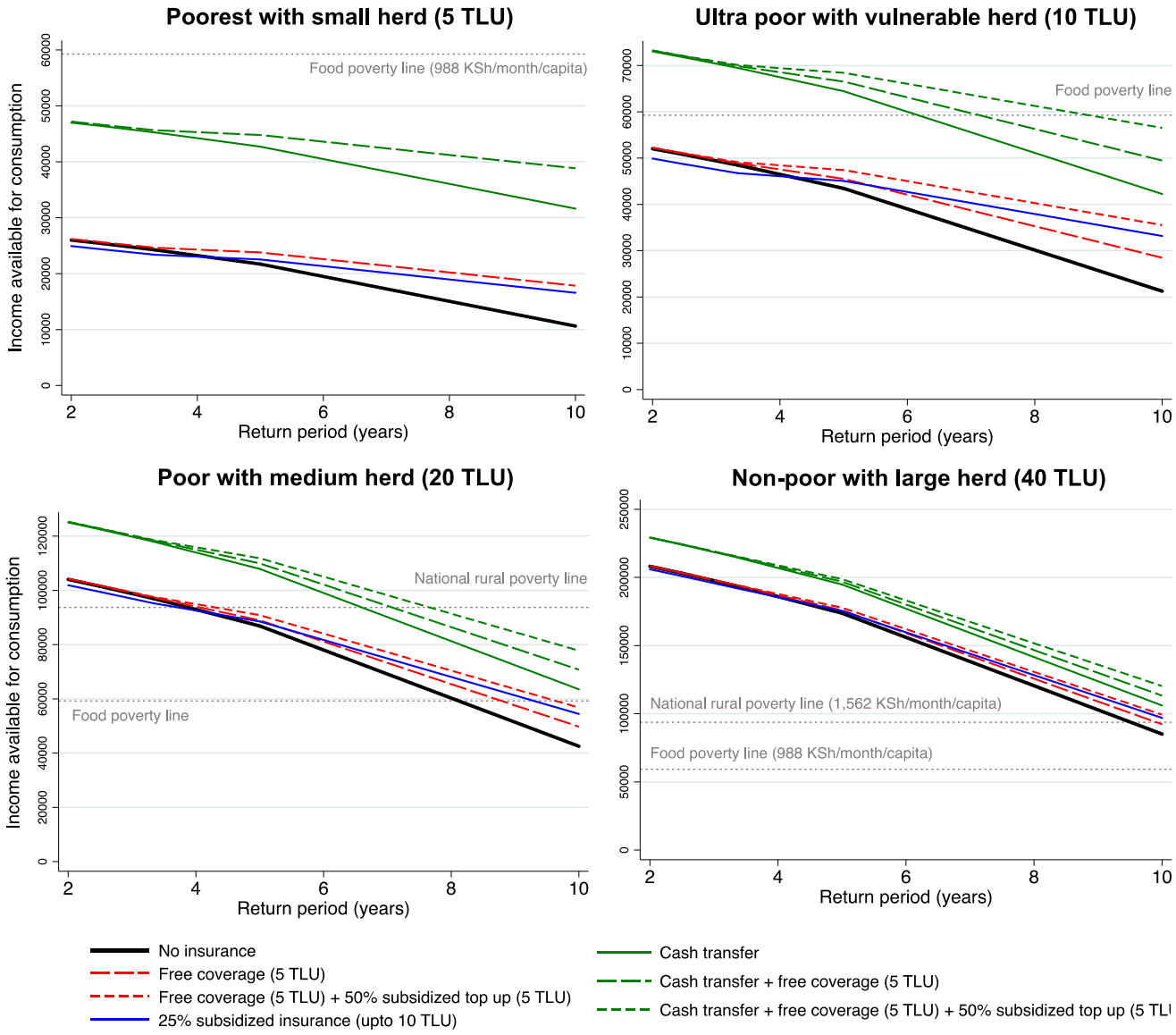


FIGURE 8: POTENTIAL IMPACTS OF LIVESTOCK INSURANCE ON HERD ACCUMULATION

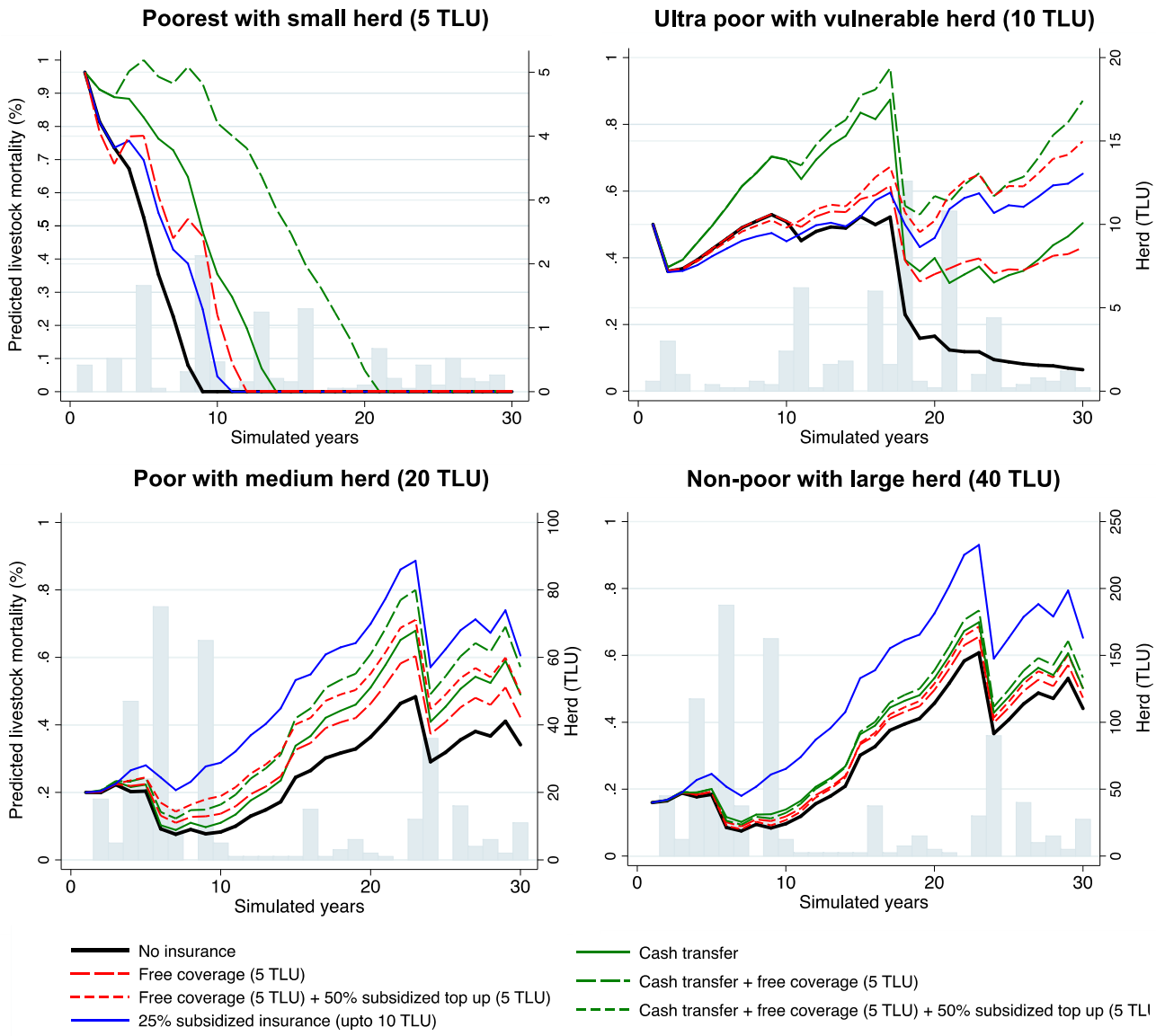
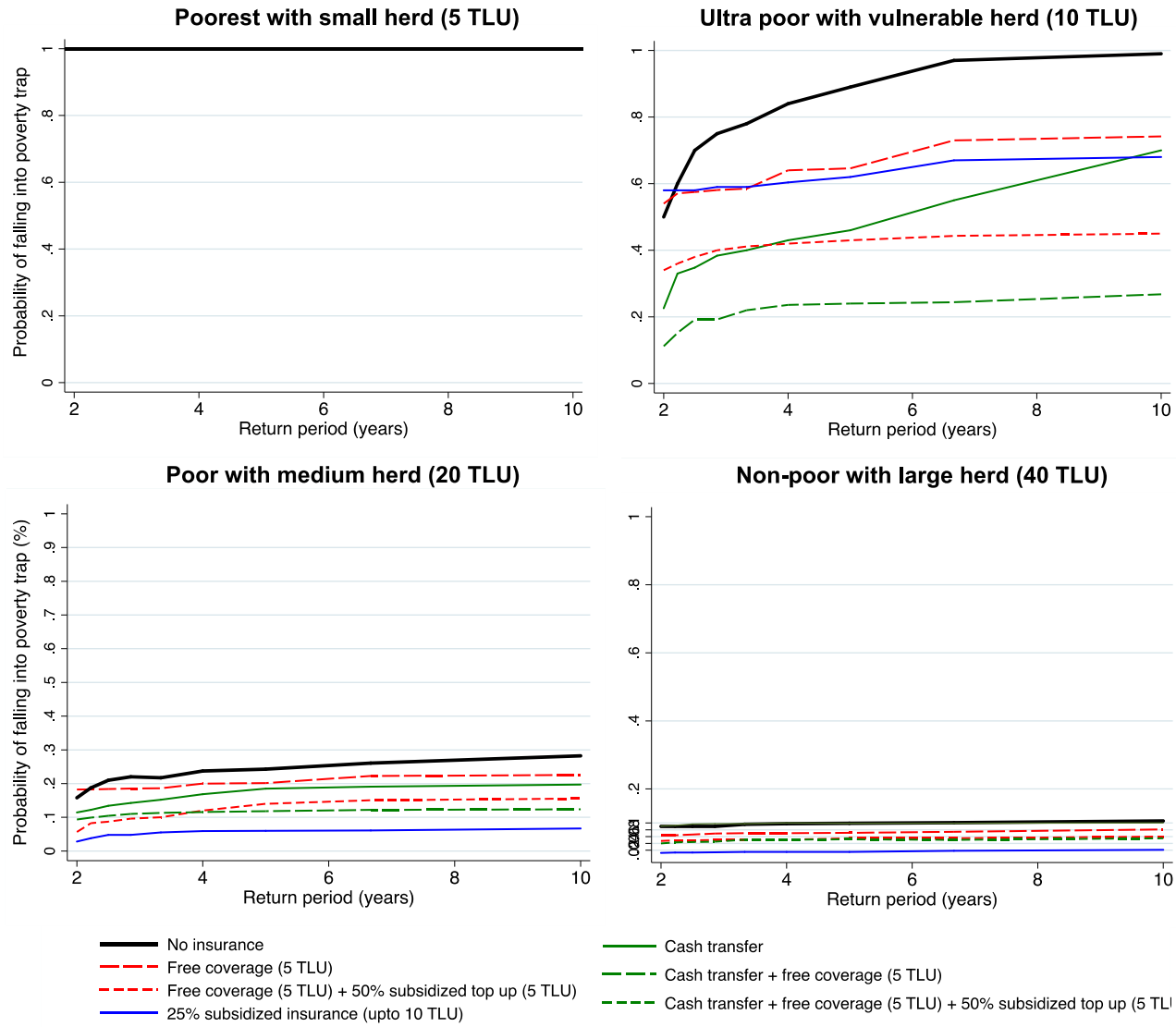


FIGURE 9: POTENTIAL IMPACTS OF LIVESTOCK INSURANCE ON PROBABILITY OF FALLING INTO POVERTY TRAP



3 CROP INSURANCE

3.1 CONTEXT

KENYA'S EXPERIENCE IN CROP INSURANCE[18]

As well documented in the recent "Situation Analysis for a National Agricultural Insurance Policy (NAIP)", prepared by the Agricultural Sector Coordination Unit (MALF), Kenya has a long tradition in developing agricultural policy programs for risk management purposes.

In Kenya, government support to agricultural insurance dates back to 1942 with the formation of the Guaranteed Minimum Return Scheme (GMR). The objectives of the GMR program were two-fold: (a) to encourage food production to meet Kenya's basic food needs through the provision of seasonal crop credit to farmers producing strategic food crops such as wheat and maize through a system of guaranteed prices for output, and (b) to provide these farmers with crop insurance in order to compensate them against drought, pests, diseases and other natural perils (Muthui 1988, Sinah 2012, Kerer 2013). The system operated for more than 30 years when issues in performance and unsustainable financial losses led to its closure between 1977 and 1978.

Interest in agricultural crop and livestock insurance re-emerged in the mid-2000s. Two main routes were explored: (1) the development of a Kenyan market crop insurance capability to underwrite traditional indemnity-based multiple-peril crop insurance (MPCI) for medium and large scale commercial farmers, and (2) the introduction of index-based insurance as a potential retail product to market to small and marginal crop and livestock producers in situations where it would be prohibitively expensive to try to operate traditional indemnity based crop and livestock insurance programs.

The re-emergence of interest in agricultural insurance in Kenya began in 2006 when four local private insurance companies came together to form a crop and livestock insurance consortium or "pool agreement" identified as Agricultural Insurance Manager (AIM). The role of the AIM consortium was to design, rate and implement traditional indemnity-based crop and livestock insurance covers including multiple-peril crop insurance (MPCI). The Pool operated from 2008 up to 2010 when it was disbanded. Since 2010, several of the companies have continued to underwrite their own separate crop and livestock portfolios.

[18] For further discussion of Kenya's experience with agricultural insurance see "Kenya - Situation Analysis for a National Agricultural Insurance Policy (NAIP)". MALF / GIZ Report. February 2014.

Kenya has subsequently witnessed an increased interest in developing crop weather index insurance (WII) product led for the most part by the Syngeta Foundation for Sustainable Agriculture (SFSA) and the Financial Sector Deepening (FSD) Kenya Program through a public sector and donor sponsored initiative.

THE INTEREST OF GOK FOR A NEW GENERATION OF AGRICULTURAL INSURANCE TOOLS

In order to reduce risk and promote growth in the agricultural sector, GoK is now placing new emphasis on the development of insurance solutions for agriculture. GoK intends to foster the generation of innovative and widespread insurance products by addressing the conditions that so far have been hampering its development.

The key assumption in this renewed interest of GoK is that a well-structured agricultural insurance program, participated by both public and private players, could be a potential solution for unlocking access to production credit and stimulate investment in productive inputs. It is now clear that, to be successful, an insurance scheme needs to reach a scale large enough to operate effectively, both in terms of the risk transfer objectives and of the commercial interests of the insurance industry. International experience shows that this is rarely achieved without an active participation of governments in building appropriate institutions and in providing financial support to willing private sector players.

The working hypothesis of the GoK is to engage in the development of a dedicated Public Private Partnership (PPP) in agricultural insurance and invest resources in supporting it financially. From a program design point of view and for illustrative purposes the approach analysed in this note is that of Area Yield Index Insurance (AYII) for maize and wheat crops. AYII would be electively retailed through credit institutions via their lending operations for agricultural inputs.

Once the PPP framework for crop insurance has been implemented, appropriate solutions for other agricultural sectors could be also developed. SDA has recommended extending future analyses to horticulture, coffee and tea. Maize and wheat have been selected as the sectors where to start from given their relevance in terms of food security (maize in particular), their major contribution to agricultural value added, and the availability of readily implementable insurance solutions.

As discussed in detail in later sections, AYII seems to be the appropriate tool for reaching the required operational scale to allow the GoK to meet its policy objectives in the grains sector. The case of India, the largest insurance program in the world per number of farmers insured (34 million farmers / 20% of farmer households), has been a

source of inspiration as an example of a PPP in agricultural insurance developed in an emerging country.[19]

3.2 DESCRIPTION OF POTENTIAL AGRICULTURAL INSURANCE PROGRAMS FOR CROPS

RATIONALE FOR SELECTING AYII IN AN AGRICULTURAL INSURANCE PPP FRAMEWORK

In considering the development of a PPP in agricultural insurance, the set of potential products for crops to select from is essentially composed of four typologies. These are: Named Peril Crop Insurance (NPCI), Multiple Peril Crop Insurance (MPCI), Weather Index Insurance (WII) and Area Yield Index Insurance (AYII) (see Figure 1).

In a mature agricultural insurance program the four different contract typologies would not be necessarily alternative solutions, and could be rather seen as complementary in providing the customers with a wide range of risk management tools which to select from. However, in the case of a nascent PPP system, the GoK will need to concentrate efforts and resources on the approach that can better suit its policy objectives, leaving other approaches to develop as the system gains momentum. Figure 1 and Figure **3** provide a summarized description of the conditions in which the use of the different products is more appropriate.

The working hypothesis explored by the GoK is to promote the development of an AYII program for maize and wheat production. By definition AYII is based on an indexed approach, where the underlying index is crop yield of a defined area called an Insurance Unit (IU). In AYII the actual yield of the insured crop in the IU is compared to the threshold yield. If the former is lower than the latter, all insured farmers in the IU are eligible for the same rate of indemnity payout.

AYII provides a wide peril coverage, if designed appropriately is not affected by adverse selection and moral hazard, and has a standardized design that can lead to rapid scalability. The main drawback of AYII is "basis risk".[20]

The more traditional NPCI (e.g., coverage for hail or frost) and MPCI (all risks combined) products are already available on offer by several insurance companies in Kenya, but given the prevalent operating conditions in Kenyan agriculture, they may not be suitable for large scale application. Such products are probably more suited for

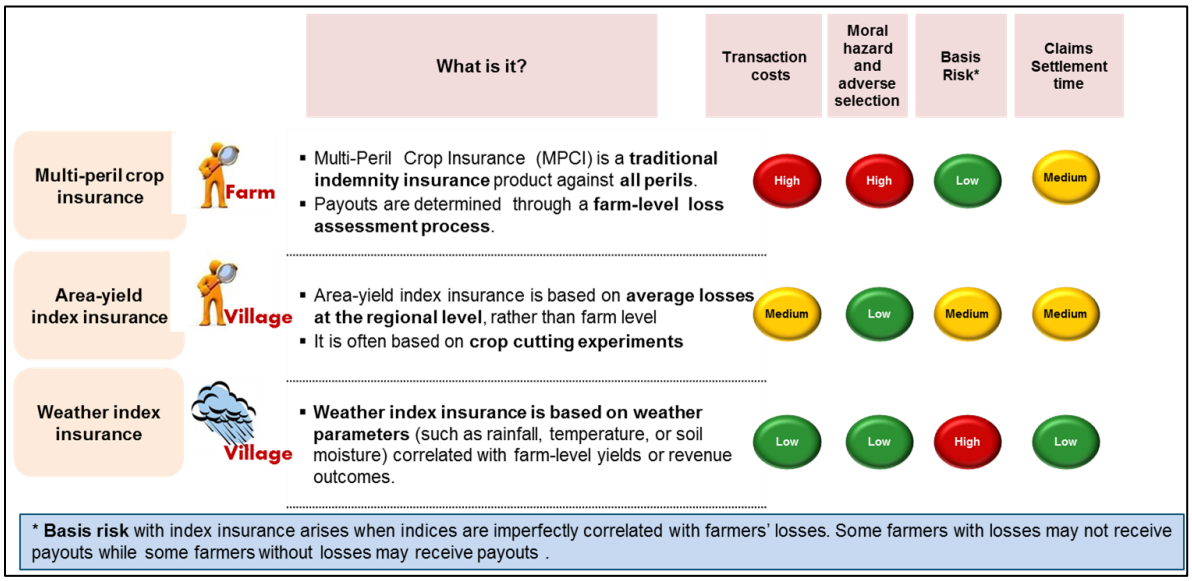
[19] For more details on the National Agriculture Insurance Scheme of India and its modifications see "INDIA – Crop Insurance Non-lending Technical Assistance – Summary of Policy Suggestions". The World Bank and GFDRR. April 2011.
[20] Definition and details on basis risk are provided below

medium and large scale commercial agriculture and less for small scale subsistence farmers and require a strong network of loss adjusters. In addition, the moral hazard and adverse selection challenges they pose are difficult to manage.

WII is an interesting innovation that has been extensively piloted in Kenya and is now starting to be retailed in niche markets. While not affected by moral hazard and adverse selection, WII covers essentially weather perils (mainly drought). Product design requires significant customized "Research & Development" activities that, together with its significant exposure to basis risk, limits the adoption of WII on a widespread scale.

GoK's motivations for investing in a PPP based on an AYII scheme seem to be supported by the welfare impact analysis presented in Section 3.4.[21]

FIGURE 10: TYPES OF AGRICLUTURAL INSURANCE PRODUCTS



Source: World Bank, Agricultural Insurance Development Program, 2014

AYII OPERATING MODALITIES[22]

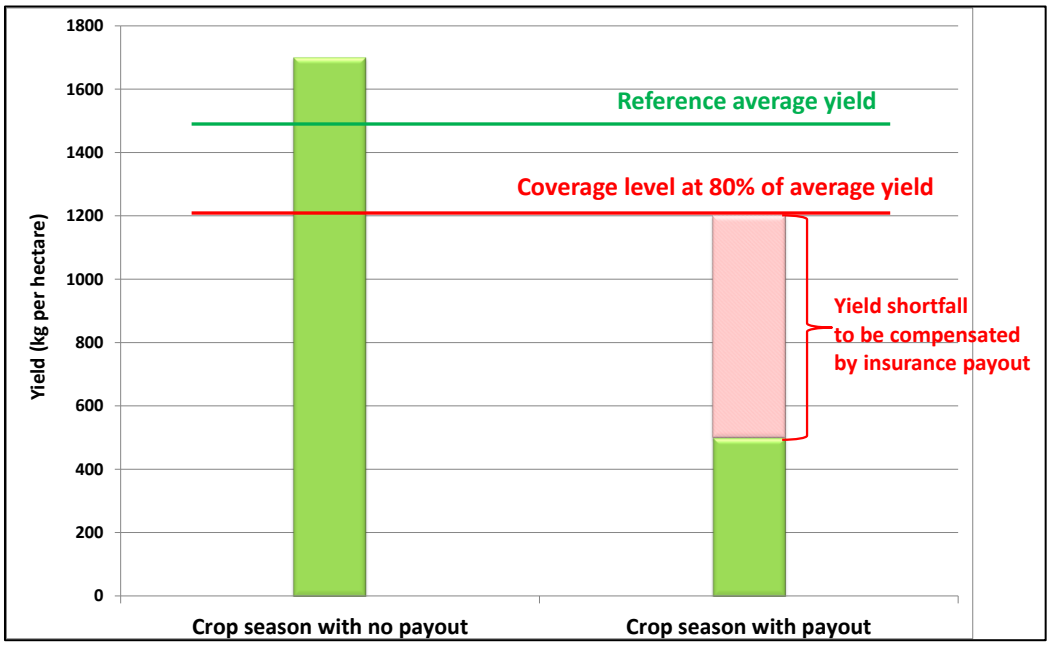
The key feature of AYII is that it does not indemnify crop yield losses at the individual field or grower level. Rather, an AYII product makes indemnity payments to growers according to yield loss or shortfall against an average area yield (the index) in a defined geographical area. An area-yield index policy establishes an "insured yield" which is expressed as a percentage (termed the "Coverage Level") of the historical average

[21] See Section 3.4 for the complete welfare impact analysis.

[22] The material presented in this section has been adapted from "Burkina Faso - Risk Management in The Cotton Sector - Index Insurance Feasibility Study - Draft Report". 30 September 2011. Agricultural Risk Management Team, The World Bank.

yield for selected crops in the defined geographical area which forms the Insured Unit (IU).[23] Farmers whose fields are located within the IU may purchase optional coverage levels, or insurers may offer only one coverage option in the Insured Unit.

FIGURE 11: COVERAGE LEVEL AND INSURANCE PAYOUTS IN AYII



The actual average yield for the insured crop is established by a statistical sample of field measurement (usually involving crop cuttings) in the IU and an indemnity is paid by the amount that the actual average yield falls short of the Insured Yield Coverage level purchased by each grower.

The key advantages of the Area-Yield approach are that moral hazard and adverse selection are minimized, and the costs of administering such a policy are much reduced. As the policy responds to yield loss at a defined area-level, and not at the level of the individual farmer, if the IU is large enough, no farmer can influence the yield indemnity payments and as such adverse selection and moral hazard are minimized. Administration costs are also greatly reduced because there is no need for pre-inspections on individual farms and loss assessment is not conducted on an individual farmer and field by field basis, but rather according to a pre-agreed random sampling of crop yields on plots within the IU.

The main drawback of AYII is "Basis Risk" or the potential difference between the insured area-yield outcome and the actual yields achieved by individual insured farmers within the insured area. Basis risk arises where an individual grower may incur severe crop yield losses due to a localized peril (e.g. hail, or flooding by a nearby river), but

[23] See Figure 11 for a graphical representation of the role of the coverage level.

because these localized losses do not impact on the area-level average yield, the farmer who has incurred severe crop damage does not receive an indemnity. In addition, basis risk may arise where individual farmer crop production and yields are highly heterogeneous (different) within the same department, which will invalidate using an area-based approach.

PROGRAM REQUIREMENTS

In order to develop a functional and effective AYII program for maize and wheat in Kenya it will be necessary to:

a) Define homogeneous producing zones (the Insured Units) with high levels of correlation between farmers of the same IU;
b) Generate an accountable, reliable and statistically accurate system of measuring actual average area-yields in the defined IU, and define on which basis payouts should be triggered where actual yields fall short of the insured yield(s).

As for any agricultural insurance program, historical data for structuring and rating AYII is fundamental. Ideally, for each of the defined IUs yield data for the past 15 years or more would be required. If and when such data is not available logistical and financial support to the insurance industry will be critical. Data sets of appropriate length and quality are indeed fundamental for the development of an AYII program. However, it is acknowledged that in the start-up phase of the program such data may not be always available. This is an area in which financial and logistical support of GoK will help the private sector to overcome the challenges related to providing insurance in the inception phase. As the program develops the data will be collected and compiled, thus generating the basis for a well-established and actuarially sound insurance program.

The data for AYII is usually collected through Crop Cutting Experiments (CCEs) on the basis of which samples of crops are harvested, dried and weighted, and yield values are inferred. This work is usually carried out by government extension officers but could also be outsourced to private entities if the number of CCEs to be carried out proves to be excessive. In this scenario, extension officers could play a key role in auditing the data collection activities. It is worth noting that SDA is currently in the process of improving its data collection system in order to harmonize it with international and regional standards. To this end, a dedicated set of Guidelines has been published in January 2014.[24] The orientation of the GoK to update and improve the data collection system, also in function of

[24] *Kenya Agricultural Data Collection and Management Guideline*, State Department of Agriculture, January 2014

the devolution process started in 2012, will certainly help a potential development of an AYII program.

Despite the efforts of the GoK to improve agricultural data collection, data requirements for AYII are very specific and may go beyond what envisioned for a traditional system of agricultural statistics. It is therefore foreseen that, where required, specific public support will be provided to allow for additional CCE activity.

For an AYII program the value of defining appropriate Insurance Units and of developing a suitable data collection system cannot be underestimated. It is therefore suggested that a specific multi-stakeholder study on how best to organize the data collection system is carried out. On top of selected SDA officials, the team for such a study should also include staff of the Kenya Bureau of Statistics, of agricultural research institutions, of the insurance industry and of any other interested party. The study would need to cover items such as: a) Risk profile-based identification of Insurance Units; b) Statistical sampling methodology for identification of plots for CCEs; c) Number of CCEs per IU; d) Procedures, roles and responsibilities for carrying out CCEs, with a potential view to outsourcing the activities for which government personnel may be overtasked; e) Training and accreditation for government and/or private sector personnel to ensure consistency with international reinsurer data collection standards; f) Reliable auditing procedures for assuring that national and international insurance community can place confidence in the quality of the data collected.[25]

As a concluding remark, it is important to stress that in designing and implementing an AYII program for Kenyan agriculture, it would be key to take into account all lessons learned in international experience in running similar programs and any opportunity provided by the latest developments in technology. Elements like real-time data transfer through mobile phone connections, digital video recording, remote sensing performance indicators, GIS mapping, GPS geo-referencing, etc., will increase the possibilities of assessing production losses in an efficient, effective and transparent way.

[25] Along these lines some of the suggested topics to be covered in the revision analysis of the NAIS system in India were the following: (i) establishment of a standardized national manual on crop cutting experiments (CCEs); (ii) systematic training and certification of loss adjusters; (iii) commission of randomized, independent, high quality CCE audits to be conducted alongside the standard CCEs; (iv) standardized statistical approach to handle outlier yields in the calculation of the area yield; (v) implementation of an auditing system, such as video recording, satellite imagery and/or additional CCEs on plots adjacent to the official CCE plots. (INDIA – Crop Insurance Non-lending Technical Assistance – Summary of Policy Suggestions, The World Bank and GFDRR, April 2011).

3.3 FISCAL COSTING ASSUMPTIONS AND SCENARIOS

The objective of this section is to provide the GoK with indicative references on the potential fiscal cost of developing an AYII insurance scheme for maize and wheat producers. In order to develop such projections it is necessary to estimate the potential cost of insurance policies and to define the key assumptions for potential policy choices and for the expected uptake of the proposed insurance products.

The cost of insurance is made up of several key components such as the cost of risk (in technical terms, the "pure risk premium"), and the charges required to cover data collection, reinsurance fees, administration costs, tax, profits, and any other cost of doing business. Such charges are often estimated as a multiple of the cost of risk and, for the purpose of this analysis, it is assumed that they will double the pure risk premium. An approximated way of estimating the insurance premium is indeed to start from the pure risk premium and scale it up by a comprehensive loading factor defined as "premium multiple". As mentioned above, for the case in object the premium multiple has been set at 2. This is to say that, for example, if in a particular area the pure risk premium rate is 6%, the final commercial premium rate at which the policy will be sold in that area will be 12%.[26]

A preliminary assessment of the pure risk premiums for both maize and wheat was carried out on the basis of historical production records provided by SDA at district level and assuming an 80% coverage level. [27] As indicated in more detail in Annex C.1, the data was carefully analyzed, revised and detrented.[28] Pure premium rates were then determined on the basis of the historical payout performance at the coverage level mentioned above.[29] Figure 12 and Figure 13 illustrate the spatial distribution of the estimated district-level premium risk rates for AYII policies for maize and wheat.

It is very important to note that the pure premium rates presented in this report are purely indicative and that the basic analysis carried out in this context has the sole objective of highlighting the diverse risk exposure of the different areas of Kenya. The responsibility to perform appropriate actuarial analyses for underwriting purposes lies with the insurance industry. In addition, it may be useful to emphasize that the maize data used in the analysis is composed of annual yield values which do not allow to account for production performance in the individual long and short rainfall

[26] In insurance transactions it is customary to refer to "premium rates" where the cost of the policies are expressed as a share of the value insured.
[27] The coverage level determines the cases in which a payout is triggered, e.g. any time that the recorded yield level in a specific area falls below 80% of the reference average yield a payout is issued. See Figure 11 for a graphical representation of the role of the coverage level.
[28] Annex C.1 also presents the district breakdown adopted in the analysis.
[29] In technical terms this process is defined as a Historical Burn Analysis (HBA).

seasons. This reduces the ability of estimating yield variability in the individual seasons and increases the uncertainty in the estimation of the pure risk rate.

FIGURE 12: ESTIMATED AYII RISK PREMIUM RATES FOR MAIZE AT DISTRICT LEVEL

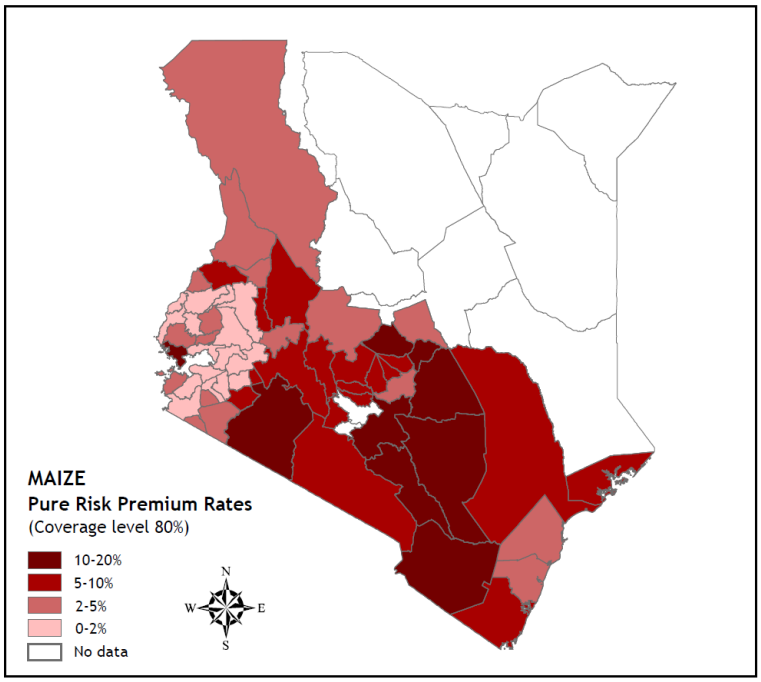
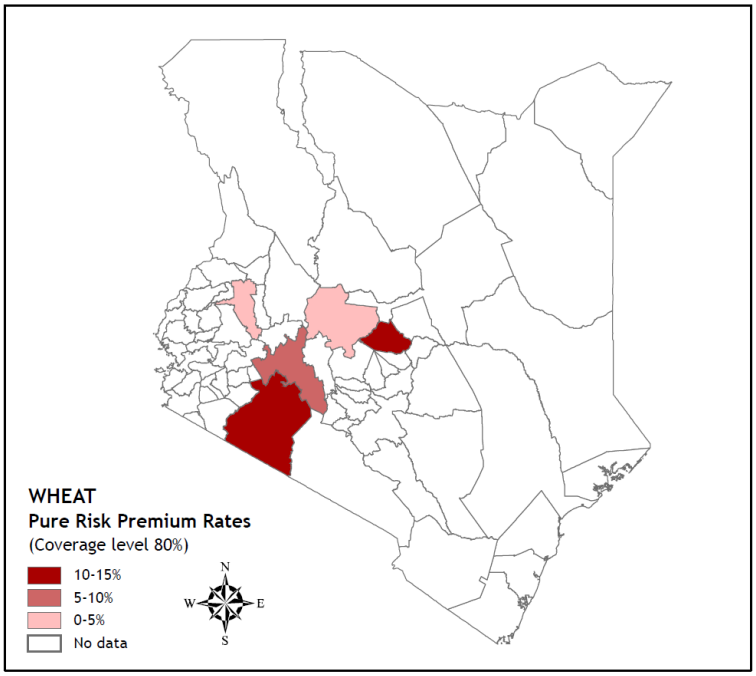


FIGURE 13: ESTIMATED AYII PURE PREMIUM RATES FOR WHEAT AT DISTRICT LEVEL



Despite the limitation in the production data available, it is still possible to identify rough operational estimates of the fiscal costs of an AYII program.[30] However, for potential implementation activities, specific care should be put in the development of seasonal based contracts.

BOX 3: COVERAGE LEVELS AND PREMIUM RATES

Table 4 provides an example of how the premium rates of hypothetical AYII contracts vary according to different coverage levels. In the cases presented below, for a coverage level of 80%, the premium rate would be below the 15% cap adopted in the simulations only for the district of Uasin Gishu. In order to meet the 15% threshold it would be necessary to reduce the coverage level to 70% for Kajiado, and to 50% for Machakos. These simple examples show the clear tradeoff between cost and coverage of AYII policies. This tradeoff is driven by the underlying risk and, where risk proves to be excessive, insurance may not represent an economically viable proposition.

TABLE 4: VARIATION OF PREMIUM RATES ACCORDING TO DIFFERENT COVERAGE LEVELS

	COVERAGE LEVEL			
DISTRICT	***80%***	***70%***	***60%***	***50%***
Machakos	31%	26%	20%	14%
Kajiado	17%	11%	7%	4%
U/Gishu	4%	3%	3%	2%

The case of Machakos is also an interesting example of how combining seasonal production data in one annual observation may distort the perception of the risk profile in the area. The extremely high premium rate estimated for Machakos is due to the inclusion of the March – May rainfall season, significantly drier than the October – December one. Seasonal production data would provide different insurance premium rates for the two seasons, leading to different risk management recommendations.

An essential assumption underlying this fiscal costing exercise is that the GoK will provide direct financial support to the AYII scheme.[31] **The first means for channeling public support will be to finance the cost of risk. In the analysis it is assumed that the**

[30] The selected coverage level (80%) generates premium rates that for some districts would be excessive and not sustainable. Hence, in order to generate more realistic projections, commercial premium rates were capped at a maximum of 15%. In a potential implementation phase it will be important to assess the tradeoff between the cost of the policies and their actual coverage capacity. In the districts in which the capping is binding, the coverage level is de facto reduced to lower levels (see Box 3 for a more detailed discussion).
[31] See section 3.4 for a more detailed argumentation on the need for public support

GoK will cover a 50% share of such costs. Risk financing support can be structured in many ways and, for the purpose of this analysis, it is assumed that it could come under the form of a dedicated "risk financing fund", covering part of reinsurance costs, or in the form of premium subsidies.

The second source of public support for AYII will be by providing resources to complement the data collection activities needed for operating the insurance scheme. For the current fiscal scenarios it is assumed that the GoK will cover the cost of the activities needed to complement the estimation process carried out by the public extension service, including costs for equipment, labor, management and auditing.[32] However, more complex arrangements can be envisioned in which the private stakeholders also play relevant roles in supporting the data collection process.

The current costing exercise does not distinguish between commercial and subsistence farming. However, different supporting schemes could be envisioned for the two farming typologies. For example, in the areas where agricultural production is carried out by smallholders at subsistence level, the program could take the form of a social protection scheme and provide higher levels of support. At the same time, in more commercially oriented production environments specific limits to the amount of subsidized insurance could be introduced. Differentiations could be also made between maize and wheat production activities, given that the latter is traditionally carried out in larger and more sustainable production units.

An important dimension to be defined for determining the value insured per district is the expected take up rate of insurance products (identified, in insurance terms, as the "degree of penetration"). As a tentative reference, the fiscal scenarios have been developed by starting at 3% of cultivated area at the beginning of the program in 2016, and reaching 15% for maize and 25% for wheat in 2023.[33] The penetration rate is clearly difficult to predict as it is a function of many variables, some under the control of the program and some not. These projections are based on the assumption that AYII will be retailed in connection to agricultural input credit operations that are currently accessed by less than 5% of farmers (see Section 4.4). The availability of AYII should allow financial institutions to expand their agricultural lending operations generating a mutually reinforcing process that could lead to a progressive increment in the take up of both insurance and credit.

Under the assumptions presented in the analysis, and excluding expenses related to other support activities, the direct fiscal costs to be borne by the GoK for supporting

[32] A detailed description of how these costs have been estimated is presented in Annex C1.

[33] A higher take up rate has been assumed for wheat since farming units are generally larger than for maize and the value chain is generally more integrated with the financial environment.

the development of a national AYII program for maize and wheat would amount to an approximated total of KSh 140 million (US $ 1.6 million) at the start of the program, and of KSh 740 million (US $ 9 million) per year when it is assumed that the program will have reached significant scale (see Table 5 and Table 6). The bulk of the estimated fiscal support would be directed to maize production that would absorb nearly 90% of resources provided by the GoK.

TABLE 5: FISCAL COSTING PROJECTIONS FOR AYII FOR MAIZE FROM 2016 TO 2023[34]

	2016	2017	2018	2019	2020	2021	2022	2023
Insurance Penetration (as a % of cultivated area)	3.0%	4.7%	6.4%	8.1%	9.9%	11.6%	13.3%	15.0%
Penetration (hectares)	61,517	96,670	131,822	166,975	202,128	237,280	272,433	307,586
Premium volume (million KSh)	253	398	543	687	832	977	1,122	1,266
Projected public support as a share of premium volume (%)	50%	50%	50%	50%	50%	50%	50%	50%
Cost of premium subsidy for GOK (million KSh)	127	199	272	344	416	489	561	633
Additional costs for data collection / yield estimation (million KSh)	0.2	0.6	1.2	1.7	2.3	2.9	3.5	3.8
Number of farmers covered (per season)	25,632	40,279	54,926	69,573	84,220	98,867	113,514	128,161
Total cost for GoK (million KSh)	***127***	***200***	***273***	***345***	***418***	***491***	***564***	***637***
Total cost for GoK (million USD at 85 KSh/USD)	***1.5***	***2.3***	***3.2***	***4.1***	***4.9***	***5.8***	***6.6***	***7.5***

[34] Additional assumptions not presented in the table: Price of maize 34 KSh/kg, Coverage level 80%, Premium multiple 2, Premium per district 15% maximum. As it is reasonable to foresee the adoption of caps in the number of hectares per farm insured under the supported program, the number of farmers covered has been calculated on the basis of the median of farms' size. As the number of farmers needs to refer to an individual season, the maize biannual production pattern for 75% of the cultivated areas has been also accounted for. See Annex C.1 for a complete recap of underlying assumptions and Annex C2 for statistics on maize production.

TABLE 6: FISCAL COSTING PROJECTIONS FOR AYII FOR WHEAT FROM 2016 TO 2023[35]

	2016	2017	2018	2019	2020	2021	2022	2023
Insurance Penetration (as a % of cultivated area)	3.0%	6.1%	9.3%	12.4%	15.6%	18.7%	21.9%	25.0%
Penetration (hectares)	3,819	7,820	11,821	15,822	19,823	23,824	27,825	31,827
Premium volume (million KSh)	24	49	74	98	123	148	173	198
Projected public support as a share of premium volume (%)	50%	50%	50%	50%	50%	50%	50%	50%
Cost of premium subsidy for GOK (million KSh)	12	25	37	49	62	74	87	99
Additional costs for data collection / yield estimation (million KSh)	0.01	0.04	0.07	0.11	0.14	0.18	0.21	0.24
Number of farmers covered	1,273	2,607	3,940	5,274	6,608	7,941	9,275	10,609
Total cost for GoK (million KSh)	***12***	***25***	***37***	***49***	***62***	***74***	***87***	***99***
Total cost for GoK (million USD at 85 KSh/USD)	***0.1***	***0.3***	***0.4***	***0.6***	***0.7***	***0.9***	***1.0***	***1.2***

3.4 WELFARE IMPACTS OF AREA-YIELD INSURANCE FOR MAIZE AND WHEAT IN KENYA

Maize and wheat productions are one of the key sources of livelihoods and food among the smallholders and medium-scaled farmers in Kenya. Maize growing areas span nationwide. The nation's key growing areas can be classified into three production zones with distinct production systems and socioeconomic conditions. The low potential zone occupies low yielding and high-risk production in Eastern and Central provinces, where the majority of farmers are poor smallholders with median farm size of 1.5 hectares and use subsistent production technology. The medium potential zone occupies the relatively higher yield but lower risk regions of Nyanza and Western provinces with slightly better off but still smallholders. And the high potential zone occupies the high yielding production regions of Rift Valley province with relatively larger scaled farmers with 2.5 hectares of land on average. Maize production is one of the main livelihoods and mainly for home consumption especially in the low and medium potential zones. This is in contrast to the high potential zone, where production is relatively more commercialized. Wheat

[35] Additional assumptions not presented in the table: Price of wheat 46 KSh/kg, Coverage level 80%, Premium multiple 2, Premium per district 15% max. As it is reasonable to foresee the adoption of caps in the number of hectares per farm insured under the supported program, the number of farmers covered has been calculated on the basis of the median of farms' size. See Annex C.1 for a complete recap of underlying assumptions and Annex C2 for a complete recap of underlying assumptions and for statistics on wheat production.

production concentrates in smaller regions of Eastern and Rift Valley provinces, is relatively more commercialized and adopted by relatively larger scaled farmers with 3 hectares of land on average. (See Table 13 for summary statistics of maize and wheat growing households)

Low investment in productive inputs and limited access to production credit have been one of the key impediments for improving productivity in both maize and wheat productions in Kenya. A combination of Tegemeo Institute's household survey data (2000, 2004), Kenya Integrated Household Expenditure Survey data (2005), KARI (2009) and Tegemeo Institute (2010) review a rather steady rates of 23-30% of maize and wheat farmers reporting using high yielding technology and hybrid seeds. **And while almost 50% of farmers reported having some kinds of input credits, less than 5% of these farmers reported obtaining credit from formal financial institutions.** Other sources of production credit include: cooperatives, SACCOs[36]S, local traders, input suppliers and other informal financial institutions. Statistically, input loans have been relatively small, just enough to afford minimum input costs and have been offered at varying interest rates of 8%-19% per year. Among other things, limited access to agricultural credit has thus served as one of the key supply-side constraints to productive agricultural investment.

Maize and wheat productions are significantly exposed to extreme production risk. De-trended district-level yield data of 30 years from 1983-2012 obtained from the MALF review that shortfalls in maize production below 80% of the district average occur at the frequency of 1 in 3 years in the low potential zone and 1 in 4-5 years in the other two maize zones and wheat region. The low maize potential zone thus appears with large exposure to production risk relative to others with significant drops in production below 50% of the district average occurring in the frequency of 1 in 5 year. While Kenyan farmers have established various informal risk sharing mechanisms that could allow unaffected farmers to help affected farmers reduce consumption shortfall from shocks, these mechanisms tend to be ineffective as insurance mechanisms against extreme production shocks, which tend to affect the whole communities.

Uninsured production risk could place significant welfare impacts on Kenyan maize and wheat farmers not only through increased vulnerability but also through reinforcing both supply and demand side constraints in smallholders' adoption of productive inputs. Extreme production risk directly affects welfare through reducing income/food available for consumption especially among the poor smallholders, whose livelihoods rely extensively on these crop productions. Exposure to extreme production risk could further reduce investment incentives especially among risk averse poor farmers. And

[36] Savings and Credit Cooperatives

empirically, uninsured risks have always been reported among farmers in the household survey as one of the key reasons for their underinvestment in production. At the same time, as agricultural loan portfolios would also be exposed to large default risk following extreme production shortfalls, lenders thus tend to limit supply of agricultural credit or offer credit at relatively high rates. Through direct effect on vulnerability and indirect effect on productivity, overall, exposure to uninsured risk could increase probability of falling into poverty among Kenyan farmers.

Our empirical analysis has reviewed the significance and variations of exposures and welfare impacts of covariate production risk on representative farmers in the key maize and wheat production zones. We develop a simple economic model to explore the potential welfare impacts on a representative farmer in each of the three distinct maize zones and overall wheat production region (see

Annex C.2. Summary of modeling and simulations of welfare analysis for crop for detail on modeling and simulation). In each production zone, we assume that a representative farmer owns a median farm size, produces with zone-specific production system and realizes zone-specific crop yields and variability. A representative farmer is credit constrained and so needs to take input loan at the beginning of the cropping year to purchase required minimum inputs. The loan is repaid using crop income obtained after the harvest. The model is then calibrated using a combination of 30 years district production data from MALF and detailed household survey data from Tegemeo Institute (2000, 2004) covering key maize growing areas of the country. Overall, maize yields vary significantly across the three production zones with the highest CV[37] of 0.49 in the subsistent maize potential zone, following by 0.34 in the high potential zone, 0.35 in the wheat region and 0.29 in the medium potential zone accordingly. Input costs vary from 50-75% of the expected crop revenues. For both crop productions, we thus assume that a farmer needs to take input loan at a median rate of 60% of expected revenue at 17% per year.

Net income available for consumption and expected loan repayment rates vary greatly with frequency and severity of shocks in all zones. The black lines in Figure 14 reflect annual maize and wheat income after netting out input loan repayment and thus the net income that would be available for household consumption. Our simulations considered both price and yield variability, and thus variations in net incomes reflect variations of both. As expected, the expected net incomes (realized in 1-in-2 year frequency) are very low and lower than the national food poverty line (at 988 KSh per capita per month) in the subsistent and medium maize zones and sit at slightly above food poverty line in the high maize potential zone and wheat region[38]. **Net incomes available for consumption could drop to or below zero at a frequency of 1 in 3 years in the subsistent zone and at a frequency of 1 in 4 years in others**, and could represent the situation when there is no income left for consumption and/or a farmer is unable to repay the full loan. **A 1-in-10 year production risk could further force a farmer in all production zones to accumulate debt of up to 80% of their expected income each year.** In reality, however, a farmer might not use all crop income to pay back loan. To make this more realistic, we computed the expected loan repayment rates assuming that a farmer will try to pay back

[37] The CV or Coefficient of Variation is the standard deviation divided by the mean and expressed as a ratio or percentage variation around mean.

[38] Since maize and wheat households would potentially earn income from other sources of livelihoods, poverty measures based on household crop income relative to either using national food poverty line (988 KSh per capita per month according to Kenya Integrated Household Budget Survey (KIHBS) 2005) or the national rural poverty line (1,562 KSh per capital per month according to KIHBS 2005) would only reflect the upper bound of poverty incidence in the region. Since maize income constitutes the majority of economic income of those households in the low maize potential areas, poverty measures for this group could well reflect their actual poverty incidence.

loan as much as the can after meeting the necessary subsistent consumption at 30% of the food poverty line. Table 14 thus reviews that the expected loan repayment rates in all zones could reduce with the occurrence of extreme shocks.[39]

Area yield index insurance (AYII) could potentially stabilize consumption in the bad years of extreme shocks that affect entire community. We first explore the potential of high-coverage AYII that pays out based on district-level yield index at a coverage level specific to each zone and that can be possible within 15% maximum commercial premium rate. With differences in yield variations, insurance coverage thus varies across zones with 50%, 85%, 80% in low, medium, large maize zones accordingly and 75% in the wheat region. Net income available for consumption is then plotted in red. As expected, AYII would reduce net income in good years, as a farmer needs to pay for the insurance premium, which is loaded at a multiple of 2. However, the key benefit of AYII is evident as the insurance payout could stabilize net income in bad years.

Especially for households that rely extensively on crop production as their main consumption, AYII that reduces variability in crop production will also reduce household's vulnerability of becoming food insecured. But when extreme shock of at least at the 1-in-4 year frequency occurs, this high coverage, commercial AYII, however, rarely guarantees enough income for at least full repayment of input loan in any of the zones. This could be due to several reasons: (i) commercial AYII is quite expensive, (ii) there are still basis risk associated with AYII that only provide protection with respect to district-level yield, not individual yield and (iii) other background risk due to uninsured variations in prices.

AYII could potentially increase ability of farmers to pay back input loans in the bad years and so increase expected loan repayment rates of the rural lenders' loan portfolio. Table 14 reviews this similar story as that in Figure 10. **Commercial AYII could stabilize loan repayment rates in bad years and so increase expected loan repayment by as much as 10% when farmer faces 1-in-10 year production risk relative to the case without AYII.**

Public supports that result in reduction in commercial premium rate could significantly improve the welfare impacts of AYII on maize and wheat households. We show that 50% reduction in commercial premium (which allows farmer to pay fair premium rate), could potentially allow AYII to stabilize net income available for consumption above zero even with the extreme 1-in-10 year risk in all but the risky

[39] We note that our model assumes away the potential that farmers can save in a good year and draw on their saving to consume and pay back loan in a bad year. One should thus only interpret our results on expected loan repayment rate as the lower bound of the potential rate.

subsistent zone. And so if a farmer always uses all crop income to repay loan, fair AYII could thus ensure full loan repayment in extreme bad years. Even if a farmer rather meets their subsistent consumption before repaying the loan, fair AYII could increase expected loan repayment by as much as 20% in extreme years relative to the case without AYII.

If insurance could further unlock access to agricultural credit and enhance farmers' investment incentives, even the commercial AYII could potentially crowd in sustainable increase in productivity in line with key recommendation of Kenya Vision 2030. Various studies have documented positive effects of de-risking agricultural production on productive investment and credit demand, e.g., Cai et al. (2012) in China, Galarza and Carter (2010) in Peru). Existing agricultural programs in Kenya have also successfully allowed banks to expand lending to farmers using insurance as pre-requisite for loan and/or bundling insurance with credit directly.

As the above analysis shows, AYII can remove some of the production risk from rural lending institutions and thus increase expected loan repayment rates, we explore the potential impacts of this possibility by allowing insured farmers to access larger loan for investment in expensive but more productive inputs (hybrid seeds, fertilizer, equipment). We used the crop and zone specific evidence of expensive input cost markup (relative to the average cost) and the expected yield improvement (relative to the average yield) from detailed maize production study of Kenya Agricultural Research Institute (KARI) in 2009 and wheat production's gross margin study of DASS (see

Annex C.2. Summary of modeling and simulations of welfare analysis for crop). Farmers who can afford to invest 126% and 138% more in productive input could improve maize yield by as much as 196% in the high potential maize zone and 182% in the medium potential zone respectively. Similar but less significant evidence is also found for wheat farmers, when 133% more investment in productive input could enhance yield by up to 139%. The productivity gain from increasing productive investment, however, could be limited in subsistent maize production zone by its low production potential and scarce rainfall. And thus, extra cost of expensive input appears to outweigh the additional yield improvement according to existing study.

So while commercial AYII might be too expensive to be useful as a stand-alone insurance in this setting, if AYII could unlock access to credit, it could potentially crowd in significant improvement in income and reduce probability of falling into poverty of farmers in all but subsistent maize production zone. As the green lines in Figure 14 show, the crowding in effect of even the commercial AYII could lead to more-than-double improvement in expect net income available for consumption in the medium and high maize potential zones and about 65% improvement in wheat region. The significant productivity gain from expanded credit with commercialized AYII could further result in 67% and 30% reduction in probability of falling into poverty of farmers in the high and medium maize production zone respectively. This crowding-in effect could be smaller for the relatively better off wheat farmers who already use relatively more expensive input and achieve relatively higher productivity. The crowding in effect of AYII might be limited for farmers in the subsistent maize potential zone, however.

Government subsidizing AYII and using AYII to crowd in productive input loans could further ensure sustainable and significant increases in productivity and thus agricultural GDP contributing towards achieving Kenya Vision 2030, and so could move many small and medium scaled farmers in some production regions out of poverty. Table 14 shows that subsidized AYII with extended productive input loan could potentially more than double production in high and medium maize production zone, and almost double production in wheat region. The program could potentially lead to 78%, 39% and 29% reduction in probability of falling into poverty of farmers in the high, medium maize zones and wheat region respectively. These poverty reduction effects come about as the AYII and credit enhance enhanced farmer's productivity, and AYII also acts as safety net to protect yield shortfalls in bad years.

Overall, the welfare impacts of AYII also varies across production zones with different degree of risk exposures, and AYII might not be suitable as interventions to improve smallholders' productivity in the subsistent maize production region. With

low expected yield but large exposure to production risk, AYII with large coverage could be too expensive to be useful for farmers in this subsistent maize zone. But the coverage level (currently at 50%) affordable within 15% commercial premium could also be too low to effectively insure net income and expected loan repayment against extreme shocks. Even with 50% premium reduction through public supports, extreme production shock could still cause serious shortfalls of consumption and expected loan repayment. The possibility that AYII could unlock credit access and so improve productivity for smallholders in this subsistent zone could also be very low given its low productivity improvement potential through increased productive input use.

The welfare impacts of AYII could also vary slightly across different insurable indices and coverage levels. Table 14 reviews that changing from district-level yield index to division level index potentially with larger correlations with the yield of the representative farmer could achieve larger reduction in net income variability. The performance of AYII in reducing income variability also decline as one moves from the high coverage with 15% maximum premium rate to the lower coverage level affordable within 10% commercial premium. This analysis assumes that there could be effective insurance demand even at the high commercial rate.

Government's support to development of AYII program could be cost effective strategies to meet various policy objectives. To identify the most cost effective types of support that can achieve different policy objectives targeted to different subsets of maize and wheat farmers, we compute KSh cost per household per year of 4 types of supports that can lead to (i) 1% reduction in poverty rate relative to the baseline without the program, (ii) 1% reduction in vulnerability rate (measured by probability of net income falling below zero), (iii) 1 KSh increase in net income available for consumption when targeted to each of the four maize and wheat areas. The types of support include (i) free provision of AYII, (ii) 50% subsidization of AYII, (iii) 50% subsidization of AYII and facilitation of access to input credit. We then compare costs of these interventions with the cost of direct cash transfer program. For the high-coverage AYII program (at 15% maximum premium rate), the free provision of AYII could cost government from 2,642 KSh/household/year in the subsistent maize zone to 34,448 KSh/household/year in wheat region. The cost thus reduces by half when government only subsidize 50% of AYII's premium cost.

Public support that could result in reduction in AYII's commercial premium and unlocking agricultural credit market could be the cost effective tools that allow government to reduce poverty, vulnerability and to improve productivity among the median farmers (smallholders) in the medium and high maize potential and wheat regions. It would cost as low as 118 KSh/household/year for government to reduce 1%

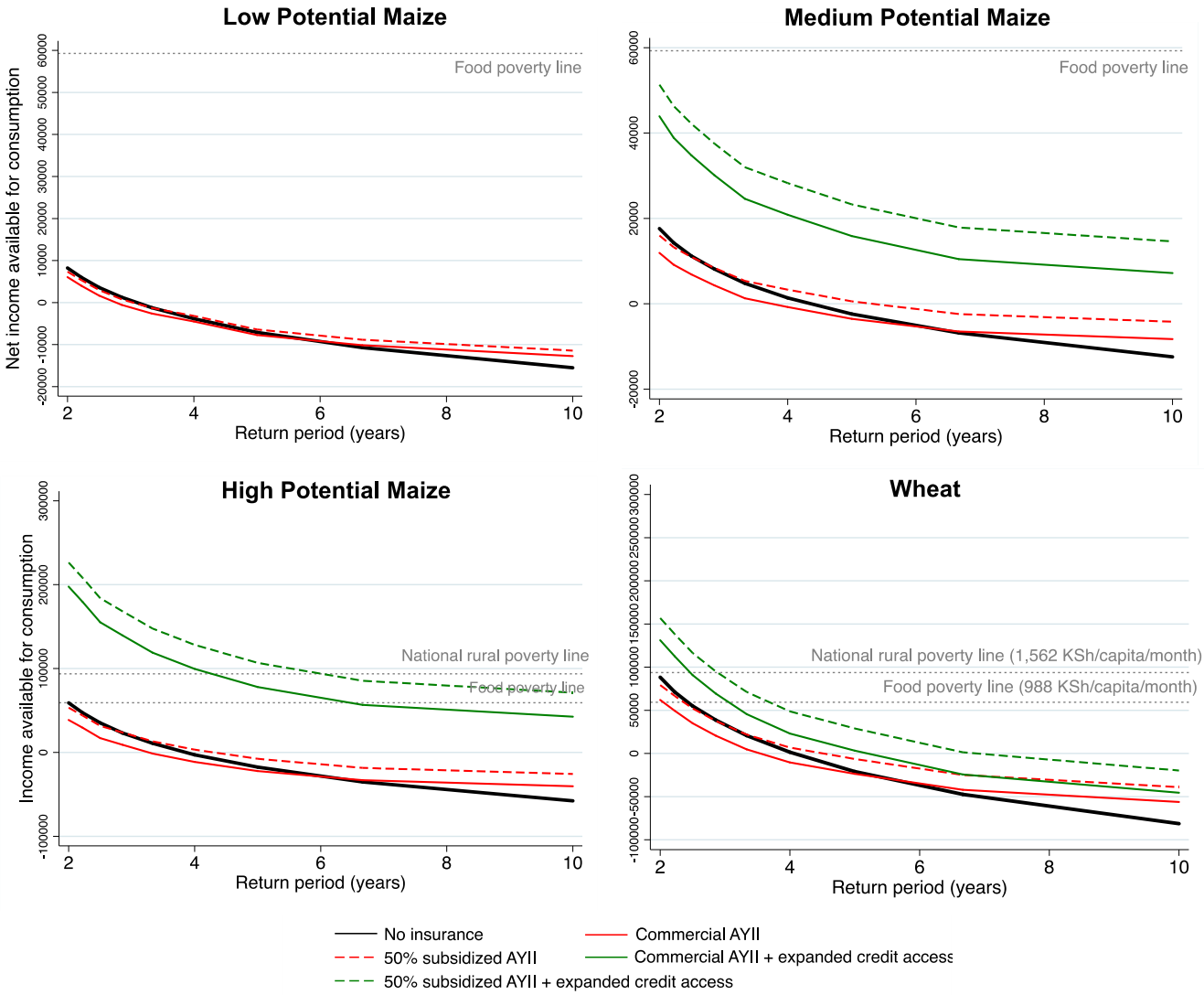
poverty rate through subsidizing AYII and crowding in input credit access in the medium maize potential zone, relative to 1,169 KSh if the government were to try to achieve the same goal through cash transfer. It would cost as low as 0.08 KSh/household/year for the same scheme in order to improve productivity and so increase household income by 1 KSh. And this is clearly cheaper than direct one-to-one cash transfer. The combination of government subsidizing AYII and crowding in input credit would not be the effective policy tool for smallholders in the subsistent maize zone, however.

Government's free provision of AYII coverage as social protection program could be the cost effective tool to reduce vulnerability of the smallholders in the subsistent maize zone. The social protection program that could lead to 1% reduction in vulnerability (i.e., the probability of household's net income falling to zero) would cost government about 761 KSh/household/year. This is cheaper than when government only provide 50% subsidy for AYII (which could cost 3,774 KSh/household/year) and the direct cash transfer (which could cost about 802 KSh/household/year). If the policy goal, however, is to reduce poverty, government's support through AYII would not be the appropriate policy tool relative to direct cash transfer program.

Policy objectives	Crop zone	Public cost (KSh) per unit			
		Free provision of AYII	Subsidize AYII	Subsidize AYII +unlock credit	Cash transfer
1% reduction in poverty	Low potential maize	no effect	no effect	no effect	1,394
	Medium potential maize	27,453	no effect	118	1,169
	High potential maize	4,425	no effect	420	1,832
	Wheat	5,408	no effect	1,722	2,355
1% reduction in vulnerability*	Low potential maize	761	3,774	no effect	802
	Medium potential maize	937	1,328	255	1,206
	High potential maize	3,540	4,963	739	2,917
	Wheat	4,804	5,235	1,679	4,175
1 KSh increase in expected income	Low potential maize	2.01	no effect	no effect	1.00
	Medium potential maize	2.02	no effect	0.10	1.00
	High potential maize	2.01	no effect	0.08	1.00
	Wheat	2.00	no effect	0.19	1.00

* Measured by probability of falling below zero net income available for consumption

FIGURE 14: POTENTIAL IMPACTS OF AYII ON NET INCOME AVAILABLE FOR CONSUMPTION[40]



[40] We note that the net income available for consumption depicted in the figure reflects crop income after any loan repayment. It does not account for the potential that household might use some part of this for saving before consumption. And thus this should be viewed as an upper bound of income that will be available for consumption.

CONCLUSION

This report provides a detailed technical analysis on the potential way forward for the GoK in developing agriculture insurance PPPs to support rural livelihoods, and realize the vision of empowering Kenya to middle-income status, as described in Kenya vision 2030. Driven by the leadership and guidance of the GoK, this report analyses the potential PPP structures to consider and the potential options for developing crop and livestock insurance programs in the short, medium and long term.

The report intends to guide GoK in key policy decisions based on the potential fiscal cost to government, in addition to the potential benefits in welfare from developing such a PPP. The fiscal costing analysis which provides estimates of resources required to develop the PPP, in addition to welfare analysis which covers the potential benefits to farmer welfare from developing agriculture insurance is intended to guide GoK in making key political decisions required to make this vision a reality. Leading the way for the African continent, these decisions will enable the appropriate policy framework to be established to form an effective agriculture insurance PPP in Kenya.

On the institutional side, key next steps of developing a NAIP are discussed, in addition to the potential institutions to be established to support the public aspect of the PPP.

For crop insurance, investments in data and linkage to credit are identified as key. Key investments in data will be required in order to develop high quality products that provide meaningful coverage to farmers, reducing basis risk and ensuring payments are made when necessary. The welfare analysis detailed the importance of linking insurance to credit, empowering rural farmers to make capital investments on their farms, increase household income and developing from small to middle, middle to large scale farms. The key costs to GoK envisaged shall be towards developing the data market infrastructure and some form of premium support.

On the livestock side, linking to the HSNP in the four northern counties in Kenya is highlighted as the first key initial step. Building on the scalable component of the HSNP, the analysis provides details of the costs and benefits of a GoK funded livestock insurance scheme that will reduce the vulnerability of low-income families, in addition to laying the building blocks for developing a politically sustainable livestock insurance market. Initially, it is envisaged that a macro level product shall be developed and given to vulnerable households. Building on this over time, top-up covers shall become available to the covered households, in addition to other households in the target counties.

Fiscally, the approach suggested in this report would entail certain cost to GoK through its involvement in the PPPs. The average cost over the first five years would be:

TABLE7: ILLUSTRATIVE FISCAL COSTING FOR AGRICULTURAL INSURANCE PROGRAMS OVER THE FIRST FIVE YEARS OF OPERATION (KSHS MILLIONS)

Program description	Estimated annual fiscal cost to national and county governments over first five years (KShs millions)	Assumed average number of producers covered over first five years	Average cost per producer per year (KShs)
Maize: area yield index insurance	273	54,900	5,000
Wheat: area yield index insurance	37	3,900	9,500
Pastoralists: satellite-based livestock protection insurance (fully subsidized)	200	72,000	2,800
Pastoralists: satellite-based livestock protection insurance (partially subsidized)	9	5,500	1,600
TOTAL	**519**	**136,300**	

ANNEX A. POSSIBLE OPTIONS FOR COINSURANCE POOLS IN KENYA

As discussed in Chapter 1, it is unlikely that insurers will be able to compete within a fully competitive market for agricultural insurance. The purpose of this section is not to make detailed recommendations for a pool structure, but to demonstrate the variety of pool structures that could be considered[41].

Non-statutory coinsurance pools

Non–Statutory Coinsurance Pools: Insurance pools can be statutory (i.e. established by specific legislation) or non-statutory (i.e. not established by specific legislation).

Different structures are commonly used to establish non-statutory insurance pools:

(a) A coinsurance pool may be established by the participating insurers as an insurer in its own right, so that it is the pool itself that issues the insurance contracts and assumes the risk on behalf of the insurers. In this case, either the pool would sell its own insurance contracts or the insurers would sell insurance contracts, as intermediaries (i.e., as agents) on the pool company's behalf, the risk being underwritten by the pool company.

(b) The insurance contracts may be written by the insurer pool members, on an individual basis, but the risk ceded to the pool. In this case, the pool may be:

  (i) a special pool company established by the insurers; or
  (ii) an arrangement between the insurers the terms of which are set out in a Pool Agreement.

(c) The insurance contracts may be written by a lead insurer on behalf of the other insurers that are members of the pool. Again, under this scenario, the pool may be a special company established by the insurers or an arrangement between the insurers set out in a Pool Agreement.

Coinsurance Pool Established as Insurer. If a coinsurance pool is established as an insurer, the pool company underwrites the risks directly in its own right. A pool company that underwrites risks must, of course, be licensed to write insurance business and must be fully capitalised as an insurer.

Other Coinsurance Pools. Coinsurance pools, whether or not established solely by contract or as a special (non–insurer) company, usually share the following features:

(a) each insurer accepts a pre–agreed share in all the risks that are covered by the pool agreement;

[41] This Annex draws, in part, on the MALF / GIZ Report

(b) all premiums are paid into the pool, less an amount to cover expenses;
(c) the pool manager or administrator assesses and settles claims;
(d) if there is an underwriting gain, the surplus (beyond any reserve retained in the pool) is paid to each insurer in accordance with its agreed share;
(e) if there is an underwriting loss, the insurers contribute to the loss in accordance with their agreed share.

If a pool is established solely through a contractual arrangement, the "pool" would not be a legal person and would not have the power to contract. The pool could not, therefore, write insurance contracts.

If the insurers enter into their own individual insurance contracts, the insurance business is conducted under their individual licenses. The capital of the participating insurers supports the risk. The position may be rather more complicated if the insurance contracts are underwritten by a lead insurer on behalf of the other insurers.

It is important to appreciate that where the insurers write their own insurance contracts and cede the risk to the pool, typically each participating insurer accepts a pre–agreed share of all the risks ceded to the pool, not just the risks that the insurer has written.

Management of Coinsurance Pools. Where a coinsurance pool is incorporated as a (non–insurance) company, the pool company will usually act as the pool manager or administrator. Where a special pool company is not incorporated, the pool may be managed by a lead insurer, by a technical management unit (TMU) contracted or employed by, or on behalf of, the participating insurers or a third party such as a broker, another non-participating insurer or a reinsurer. The participating insurers typically share the management costs in accordance with their proportionate risk share.

Statutory Coinsurance Pools

Statutory insurance pools are often, but not necessarily, corporate bodies. Usually, statutory coinsurance pools are part of a national or regional program and are usually established as part of a PPP. The legislation typically provides for the governance of the pool and sets out the pool's functions. The legislation may also cover other matters, such as the provision of some form of subsidy. Because they are established by legislation, statutory pools take many forms and may be structured very differently to a typical voluntary pool.

The legislation may establish a coinsurance pool, but not as a corporate body. For example, the pool may be established as a contractual arrangement between participating insurers. In this case, although the legislation would set out the functions of the pool, those functions would not usually include acting as an insurer as the pool is not a legal person. Of course, the legislation may establish a corporate body to act as manager of the pool, but not to write insurance contracts.

The legislation establishing the pool would usually provide the pool with exclusive rights in relation to the business underwritten by the pool. This is necessary to prevent

non-pool insurers undermining the pool by offering similar insurance products at a lower, non-sustainable, price.

Statutory coinsurance pools sometimes operate as hybrids, with some limited reinsurance functions.

BENEFITS OF AN AGRICULTURAL INSURANCE POOL

All co-insurance pools bring benefits but also have limitations. These are summarized in Box 4 (Mahul & Stutley 2010).

BOX 4: BENEFITS AND LIMITATIONS OF CO-INSURANCE POOL ARRANGEMENTS

BENEFITS

Economies of scale through operating as a single unit with shared (pooled) administration and operating functions leading to costs savings due to:
* Reduced staffing requirements (fixed costs);
* Shared costs of product research and development, actuarial and rating;
* Reduced costs of underwriting and claims control and loss adjustment.

Cost advantages in purchasing common account (pooled) reinsurance protection rather than each company trying to place its own reinsurance program. Advantages due to:
* Stronger negotiating position with reinsurers;
* Larger and more balanced portfolio and better spread of risk;
* Reduced costs of reinsurance due to pooled risk exposure;
* Reduced transaction costs (reinsurance brokerage, etc).

No competition on rates in a soft market and ability to maintain technically set rates. Most pools operate as the sole insurance provided or monopoly (e.g. Austria, Senegal, Spain, Turkey), and there is therefore no competition on pricing.

Ability to maintain underwriting and loss adjustment standards. Under a pool monopoly arrangement, the pool manager can ensure that common and high standards are maintained in the underwriting of crop and livestock insurance and in the adjusting of claims. Where companies are competing against each other for standard crop insurance business, there is often a problem of varying loss adjustment standards between companies.

Advantages of coordinating Government Support to a Pool under a Public Private Partnership: It is much easier for governments under PPP arrangements to coordinate national agricultural insurance policy and planning and specific support functions (e.g. provision of premium subsidies, research and development, education and training) to a single insurance entity (Pool) than it is to try dealing with individual insurers, each which may have very different priorities for agricultural insurance.

LIMITATIONS

A Pool may act as the sole agricultural insurer, resulting in lack of competition in the market in terms of the:
* Range of products and services offered by the monopoly pool underwriter;
* Restrictions on the range of perils which are insured;
* Restrictions on the regions where agricultural insurance is offered and/or the type of farmer insured;
* Lack of competitiveness in premium rates charged by the pool.

Source: Mahul & Stutley 2010

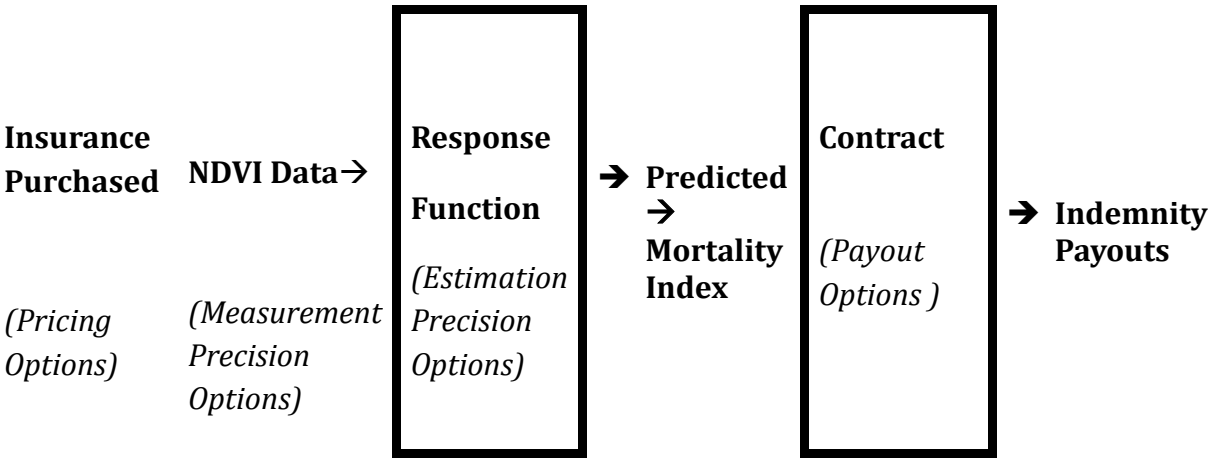
INTERNATIONAL PRECEDENTS

There are a number of precedents that could be considered by the Task Force (if established). These include:

(a) The Turkish Agricultural Insurance Pool (TARSIM).
(b) The Spanish Agricultural Insurance Pool (AGROSEGURO).
(c) The proposed Mongolian Index-Based Livestock Reinsurance Company (which will have features of a pool and a reinsurance company).

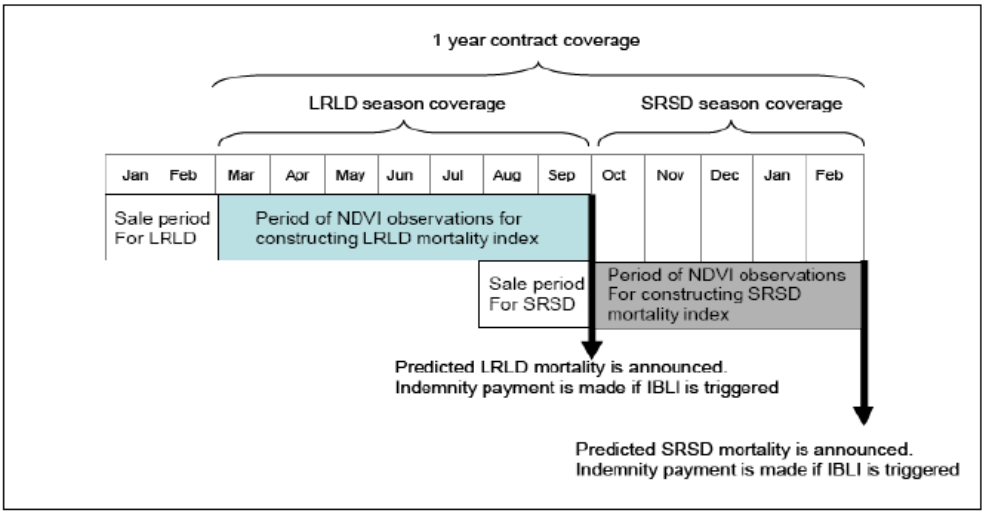
The Turkish and Spanish Pools are considered in more depth in the MALF/GIZ Report.

1. Translating NDVI Data into Estimated Livestock Mortality& IBLI Payouts



Source: ILRI 24/03/2014

2. IBLI Seasonal Sales Periods, Contract Cover Period and Contract Payout Dates



Source: ILRI 2013

3. IBLI Livestock Insurance Results 2009 to 2012 in US$ (exchange rate 1US$ = KShs . 80)

Sales period	Year	No contracts sold	No. Tropical Livestock Units Insured (TLU's)	Total Sum Insured TSI (US$)	Premium Paid by Herders (US$)	Average No. Insured TLU's per Herder	Average Sum Insured per TLU (US$)	Average Premium rate %	Average Premium per Herder (US$)
jan/feb	2010	1,974	5,965	1,118,437	46,602	3.0	187.50	4.2%	23.6
jan/feb	2011	595	1,229	230,437	9,033	2.1	187.50	3.9%	15.2
aug/sept	2011	509	836	156,750	6,122	1.6	187.50	3.9%	12.0
aug/sept	2012	219	413	77,437	3,150	1.9	187.50	4.1%	14.4
		3,297	**8,443**	**1,583,061**	**64,907**	**2.6**	**187.50**	**4.1%**	**16.3**

Source: ILRI 2013.

ANNEX B.2. ASSUMPTIONS AND PARAMETERS FOR FISCAL COSTING SCENARIOS FOR LIVESTOCK

1. Fiscal costing for the macro-level insurance coverage for asset protection

The fiscal costing scenarios for the macro-level NDVI-based index insurance coverage for livestock asset protection have been developed in order to forecast its performance in terms of number of pastoralists covered on the basis of the budget references provided by SDL: KSh 100 million, KSh 200 million, and KSh 300 million.

For each budget scenario, two extreme cases are presented. CASE A is structured by selecting, within a reasonable range of variation, the more costly extremes of the key parameters (i.e., higher values per TLU insured, a higher number of TLU per policy, and a higher insurance premium estimate). This will define a lower bound for the number of pastoralist to be covered for the reference budget figure. CASE B takes into account the less expensive options, thus identifying the higher bound of the number of pastoralist to be covered on the basis of the given budget.

TABLE 8: FISCAL COSTING PROJECTIONS FOR MACRO-LEVEL ASSET PROTECTION COVERAGE

	SCENARIO KSh 100 million (US $ 1.2 million)		SCENARIO KSh 200 million (US $ 2.3 million)		SCENARIO KSh 300 million (US $ 3.5 million)	
	Case A	Case B	Case A	Case B	Case A	Case B
Budget available for Macro-level asset protection coverage - KSh	***100,000,000***	***100,000,000***	***200,000,000***	***200,000,000***	***300,000,000***	***300,000,000***
Sum Insured per Tropical Livestock Unit (TLU) - KSh	5,000	3,500	5,000	3,500	5,000	3,500
No of TLUs insured per vulnerable pastoralist	7.5	5	7.5	5	7.5	5
Sum Insured per pastoralist - KSh	37,500	17,500	37,500	17,500	37,500	17,500
Premium Rate (as a share of sum insured)	15.0%	10%	15.0%	10%	15.0%	10%
Premium per pastoralist - KSh	5,625	1,750	5,625	1,750	5,625	1,750
Cost of registration and enrolment per pastoralists - KSh	0	0	0	0	0	0
Cost of education and training per pastoralist - KSh	10	10	10	10	10	10
Cost of payout distribution - KSh	15	10	15	10	15	10
Cost of contract design and data processing (lump sum) - KSh	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000	5,000,000
Cost of auditing (lump sum) - KSh	1,000,000	1,000,000	2,000,000	2,000,000	3,000,000	3,000,000
No of pastoralists eligble for livestock asset protection coverage	***16,637***	***53,107***	***34,159***	***109,040***	***51,681***	***164,972***

The assumptions and considerations that have led to the selection of the parameters presented in **Table 8** are the following:

- **Sum Insured per TLU**: Each TLU is valued at KSh 5,000 in CASE A and at KSh 3,500 in CASE B. Values lower than KSh 3,500 are not considered meaningful.

- **Number of TLUs insured per vulnerable pastoralist:** The number of eligible TLUs has been set at 7.5 in CASE A and at 5 in CASE B. 5 TLUs are considered to be the level below which an insurance coverage would not provide useful support to pastoralists' livelihoods.

- **Sum insured per pastoralist:** The reference sum insured per pastoralist is obtained by multiplying the number of TLUs to be covered by the selected value of one TLU. The parameters selected in **Table 8** lead to determine a range of sums insured between KSh 37,500 (CASE A) and KSh 17,500 (CASE B). The difference between the two extremes is significant, highlighting how the policy choices that will be made in selecting the relevant parameters will have a marked influence on the support provided to pastoralists.

- **Premium Rate:** As the NDVI asset protection product is still in the design phase, actual estimates for the potential premium rates of the program are not available. Hence, while the necessary elaborations are being carried out, reference has been made to the current average premium rates of the IBLI products. The IBLI scheme allows pastoralists to select between two trigger options. The average premium for the products with the lower trigger (hence the version that provides payouts more frequently) is 16.06%, while the average premium for the higher trigger option is 9.24%. Hence, approximating such figures, the premium rate for CASE A has been set at 15% and the premium rate for CASE B at 10%.

- **Premium per pastoralist:** The premium per pastoralist is obtained by applying the selected premium rate to the sum insured per pastoralist. The premium amount for CASE A is set at KSh 5,625 and for CASE B at KSh 1,750. Again, the spread between the two figures is quite significant and this has relevant implications for the cost of the program.

- **Cost of registration and enrolment per pastoralist:** In the current simulations the cost for registration and enrolment has not been considered. The rationale for this is that the target pastoralists belong to the HSNP framework and, therefore, could be registered automatically without generating any specific cost. However, the technical chapter on livestock suggests that "initial registration for households eligible for GoK subsidy would not be automatic, but would need to be completed in person", and this since the ultimate objective would be to create a sustainable market for livestock insurance, and ensuring that pastoralists understand the details of how the scheme operates may add value to the program. In addition, these activities could help spreading awareness of the insurance product and, therefore, promote the purchase of the Top-Up option and encourage Non-Target pastoralist take up the insurance product.

- **Cost of education and training per pastoralist:**
  It has been assumed to add KSh 10 per pastoralist.

- **Cost of payout distribution:**
  Given that the enrolled pastoralists will all be equipped with bank accounts, costs for distributing the payouts should be minimal. In practice, these would amount to the cost of the bank transfer operation. The value of KSh 15 for CASE A and of KSH 10 for CASE B have been assumed starting from an hypothetical figure of KSh 100 as the cost of a bank transfer operation, and also considering that that a payout would be triggered once every x years (meaning that the program would not have to bear the cost of wiring a payout to all pastoralists every year).

- **Cost of contract design and data processing:**
  Costs of US $ 50K or US $ 100k have been assumed for handling NDVI data processing and monitoring the contract.

- **Cost of auditing:**
  An auditing cost of 1% of the value of the program has been assumed.

2. Fiscal costing for the "Top-Up" and "Non-Target" purchases

As mentioned above, an optional "Top-Up" coverage for pastoralists enrolled in the program will be made available in year 3 of program implementation. In addition, pastoralists that have not been part of the initial support program will also have the option to purchase the NDVI-based insurance coverage as a "Non-target" group of pastoralists. The first layers of both the Top-Up option and the "Non-Target" group coverage will be partially subsidized.

To begin with, it should be highlighted that the suggestion to make the Top-Up and Non-Target group coverage available at year 3 of program implementation is motivated by the significant challenges to be faced when moving beyond a fully subsidized coverage scenario. In addition, the NDVI-based asset protection scheme is still in the design phase, hence before launching it on a semi-commercial basis it will be necessary to carefully assess its performance. Given the above, it is still to be determined whether for these additional options the GoK may support the asset protection structure, the ILRI's IBLI product or both. However, for the purposes of this analysis, given that the values of selected parameters have been defined on the basis of the IBLI experience, the simulations would still apply.

TABLE 9: FISCAL COSTING PROJECTIONS FOR TOP-UP AND NON-TARGET PASTORALISTS OPTIONS

	2017	2018	2019	2020	2021
TOP UP Option					
Reference premium cost per pastoralist - KSh	3125	3125	3125	3125	3125
No of vulnerable pastoralists to purchase Top-Up option	1,000	3,250	5,500	7,750	10,000
Premium volume - KSh	3,125,000	10,156,250	17,187,500	24,218,750	31,250,000
Projected Public Premium support (%)	50%	50%	50%	50%	50%
Cost of public support for TOP-UP option - KSh	***1,562,500***	***5,078,125***	***8,593,750***	***12,109,375***	***15,625,000***
Expansion to NON-TARGET pastoralists					
Sum Insured per Technical Livestock Unit (TLU) - KSh	5,000	5,000	5,000	5,000	5,000
Maximum no of eligible TLUs per pastoralist - KSh	10	10	10	10	10
Values of additional Sum Insured per pastoralist - KSh	50,000	50,000	50,000	50,000	50,000
Premium Rate (as a share of sum insured)	12.5%	12.5%	12.5%	12.5%	12.5%
Premium per pastoralist - KSh	6,250	6,250	6,250	6,250	6,250
No of non-target pastoralists to purchase coverage	1,000	2,000	3,000	4,000	5,000
Premium volume	6,250,000	12,500,000	18,750,000	25,000,000	31,250,000
Projected public premium support - %	25%	25%	25%	25%	25%
Projected public premium support - KSh	1,562,500	3,125,000	4,687,500	6,250,000	7,812,500
Costs for implementation as a share of premium support - %	200%	175%	150%	125%	100%
Costs for implementation - KSh	3,125,000	5,468,750	7,031,250	7,812,500	7,812,500
Cost of public support for NON-TARGET pastoralists - KSh	***4,687,500***	***8,593,750***	***11,718,750***	***14,062,500***	***15,625,000***
Total cost for GoK (million KSh)	***6.3***	***13.7***	***20.3***	***26.2***	***31.3***
Total cost for GoK (million USD at 85 KSh/USD)	***0.1***	***0.2***	***0.2***	***0.3***	***0.4***

The assumptions and considerations that have led to the selection of the parameters presented in **Table 9** are the following:

Top-Up Option

- **Reference premium cost per pastoralist:** The reference premium cost per pastoralist has been obtained by assuming the average standard conditions developed for the macro-level coverage. Hence, the KSh 3,125 value derives from a sum insured per TLU of KSh 5,000, 5 additional TLUs to be covered, and a premium rate of 12.5% (average of rates assumed for the macro asset protection).
- **Number of vulnerable pastoralists to purchase Top-Up option:** The assumed take up progression for the Top-Up option starts with 1000 policies in year 1 and reaches 10,000 policies after 5 years of implementation**.**
- **Premium volume:** The premium volume is obtained by multiplying the premium cost by the number of pastoralists purchasing the coverage.
- **Projected Public Premium support:** It is assumed that GoK will cover 50% of the cost of the coverage**.**

Expansion to NON-TARGET group pastoralists

- **Sum Insured per TLU:** In analogy to with the Top-Up option, the value of a TLU is set at KSh 5,000.
- **Maximum number of eligible TLUs per pastoralist:** Pastoralists not belonging to the original target group will be able to purchase supported coverage for a maximum of 10 TLUs**.**
- **Values of additional sum insured per pastoralist:** The reference sum insured per pastoralist is obtained by multiplying the number of TLUs to be covered by the selected value per TLU.
- **Premium Rate:** Same as for Top-Up option.
- **Premium per pastoralist:** Same as for Top-Up option.
- **Number of non-target pastoralists to purchase coverage:** The assumed take up progression for the Non-Target group purchases starts with 1,000 policies and reaches 5,000 policies after 5 years of implementation**.**
- **Premium volume:** Same as for Top-Up option.
- **Projected public premium support:** It is assumed that GoK will cover 25% of the cost of the coverage.
- **Projected public premium support:** The projected public premium support is obtained by applying the share of premium that will be supported by GoK to the estimated premium volume.
- **Costs for implementation as a share of premium support: I**mplementation costs refer to extension, marketing, capacity building, training and infrastructure deployment. They are estimated by referring to the IBLI experience and to the parameters that ILRI researchers have developed for future projections.
  The implementation costs are in a ratio of 5:2 with premium support cost in the short term, and in a ratio of nearly 1:1 in the medium term. These are the references that have been adopted for estimating these costs.
- **Costs for implementation:** The actual costs for implementation are obtained by applying the assumed percentage share to the projected premium support figures.
- **Cost of public support for NON-TARGET pastoralists:** Sum of the projected premium support and the costs for implementation.

A. A dynamic economic model

1. **Household consumption and livestock accumulation:**
Consider a dynamic model of a representative pastoral household, who livelihood relies primarily on livestock production. At the end of each season $t = LRLD, SRSD,$ where $LRLD$ refers to long rain-long dry season (March-September) and $SRSD$ refers to short rain-short-dry season (October-February), this household earns and consumes from total income from milk production $m(H_t)$ out of their own livestock H_t, of which they can sell the milk at the on-going market price p_t^m. The income available for consumption each period is thus $p_t^m m(H_t)$.
If milk production income is not enough for consumption, household can also consume out of their own herd by off-taking (sale or slaughter) some of their livestock at the ongoing market price p_t^h. Household can also use left over milk production income to invest more in their herd by buying livestock at the on-going market price.
Household makes intertemporal decisions by choosing optimal consumption and herd investment each period to maximize their expected lifetime utility function, of which they draw welfare gain from consumption as well as livestock.[42] And β represents the rate that household discount future. Let o_t represent the net livestock off-take (the number of herd sold and slaughtered netting out herd purchased) at the end of each season, we write household's intertemporal decision as

$$\max_{c_t} E \sum_{t=0}^{\infty} \beta^t u(c_t, H_t) \quad subject\ to \quad c_t = p_t^m m(H_t) + p_t^h o_t$$

$$H_{t+1} = (1 + b_{t+1} - m_{t+1})(H_t - o_t)$$

At the end of each season, household herd netting out net herd off take would be accumulated toward the next season herd. Herd can grow at natural biological birth rate b_{t+1} and is also subjected to mortality shock in that period m_{t+1}.
Droughts that could lead to catastrophic livestock mortality could thus affect household herd, which could place immediate effect on reducing current milk production income and longer-tem effect on disrupting herd accumulation in the following periods.

2. **Poverty trap and economically viable herd in ASAL region**
With limited productive non-livestock livelihood options and the need for seasonal migration as adaptation to climate variability, pastoral households in this region consume a good portion out of their own herd each season (e.g., through direct slaughtering or off-taking for cash). This necessary consumption out of own herd each season tends to slow down and disrupt natural herd growth especially for very small herd. Existing academic research (Lybbert et al. 2004, Barrett et al. 2008, Santos and Barrett 2013, Chantarat et al 2014, among others) have thus identified the existence of a critical herd size of about 10-15 TLU that will be necessary to sustain a viable herd accumulation in this region. Households with small herd sizes (below the critical threshold) thus tend to deplete their herds over time.
We stylize our model to replicate this empirical evidence and simplify household's dynamic problem by imposing a minimum subsistent consumption $\bar{c}$ such that household's decision become

[42] This reflects the reality of the pastoral households in the regions, where livestock also provides intrinsic value beyond just serving as store of wealth.

$$\max_{c_t} E \sum_{t=0}^{\infty} \beta^t u(H_t) \quad subject\ to \quad c_t = p_t^m m(H_t) + p_t^h o_t$$

$$H_{t+1} = (1 + b_{t+1} - m_{t+1})(H_t - o_t)$$

$$c_t \geq \bar{c},\ H_t \geq 0$$

So each period a household will try to first meet subsistent consumption $\bar{c}$ by drawing out of own herd (e.g., selling off herd for consumption or slaughtering herd), then they will try their best to accumulate livestock to maximize their herd size.

The optimal herd off-take each season can thus be written as $o_t = \frac{\bar{c} - p_t^m m(H_t)}{p_t^h}$. And the optimal herd accumulation dynamic is thus

$$H_{t+1} = (1 + b_{t+1} - m_{t+1})(H_t - \left(\frac{\bar{c} - p_t^m m(H_t)}{p_t^h} \right))$$

Those with small herd will meet $\bar{c}$ by off-taking out of own herd at the rate faster than the net herd growth. Their herd thus tends to decline – instead of grow – over time. The above herd accumulation dynamic above could thus imply the existence of an economically viable herd H^* necessary to sustain seasonal herd growth each period:

$$E\left(\frac{dH_{t+1}}{dH_t}\right) \geq 0 \quad if\ H_t \geq H^*$$

$$< 0 \quad if\ H_t < H^*$$

Furthermore as poor households tend to be to credit constrained, this prevents them from being able to restock their herds up to the economically viable and sustainable levels. So while we should expect household with $H_t \geq H^*$ to grow herd over time, those with $H_t < H^*$ will unavoidably de-cumulate herd over time and tend to be trapped in small herd size and low consumption – the poverty trap researchers found in this vulnerable pastoral region.

3. **Risk:**

Livestock rearing in this region is prone to various shocks leading to mortality m_t. Livestock mortality could be caused by idiosyncratic factors, e.g., disease, sickness, accidents, etc. as well as covariate catastrophic droughts. With the presence of viable herd, mortality rate that lead to herd collapse below H^* could please long-term consequence trapping household in the irreversible collapsing herd dynamic, instead of the growing one without shock.

Normalized difference vegetation index (NDVI), has been used to monitor the onset and intensity of droughts in the region. ILRI has thus used NDVI series observed throughout each season in a particular division to try to quantify the potential livestock losses due to drought in each season in that division through spatial econometric technique.[43] The constructed 'NDVI-based predicted division-averaged livestock mortality' $m(NDVI_t)$ for each division in each season thus reflect the division averaged livestock mortality due to drought. As widespread droughts have been one of the very key causes of livestock mortality in this region, we should expect individual livestock mortality experience m_t to co-move with $m(NDVI_t)$.

In order to understand this empirical relationship, we describe joint distribution of individual herd mortality m_t and the predicted division average livestock mortality due to drought $m(NDVI_t)$ with a bivariate truncated normal distribution:

$$f\big(m_t, m(NDVI_t)\big) \sim N(\mu_{m_t}, \mu_{m(NDVI_t)}, \sigma_{m_t}, \sigma_{m(NDVI_t)}, r_{m_t, m(NDVI_t)})$$

[43] See Woodard et al. (2014) for detail.

where $\mu_{m_t}, \mu_{m(NDVI_t)}$ represent long-term average levels of individual herd mortality and predicted drought-related division averaged livestock mortality rates, $\sigma_{m_t}, \sigma_{m(NDVI_t)}$ describe long-term standard deviations of the two mortality series and $r_{m_t,m(NDVI_t)}$ represents correlations of the two series observed in the empirical data. In the areas with large exposure to droughts, we should expect individual herd mortality to move together with the drought-related division mortality and thus $r_{m_t,m(NDVI_t)} \rightarrow 1$.

Livestock prices are also uncertain. During drought that could cause large livestock mortality, animals tend to be weak and together with lower demand in the local market, livestock price could potentially drop. We thus describe joint relationship among $p_t^h, m_t, m(NDVI_t)$ in a joint multivariate normal distribution with a correlation matrix capturing meaningful correlations of these three series.

While milk prices could also be uncertain. We observe relatively stable prices across different seasons in each area. We thus assume that they are deterministic at their mean level.

4. NDVI index based livestock insurance

Using objectively measured NDVI data to trigger insurance payout, NDVI index based livestock insurance for these HSNP counties could be of two forms

(i) ***An asset replacement insurance***: aims to compensate insured household for their livestock losses by making payout at the end of each season if $m(NDVI_t)$ is above a pre-determined strike level m^*. And so the seasonal indemnity payout per insured TLU is

$$\pi^r = \max[m(NDVI_t) - m^*, 0] \times p$$

where p is a replacement cost per TLU. The product was already designed by ILRI and has been on sale in two of the four HSNP counties.

(ii) ***An asset protection insurance:*** aims to provide timely cash to allow insured household to engage in actions (e.g., purchase forage supplement, water or to afford migration to better forage/water sources, etc.) to save their livestock from the slow-onset drought by making payout as early as possible at the end of every month in the coverage season when monthly NDVI falls below a pre-determined strike level $NDVI^*$. The seasonal payout is thus the sum of the monthly payout:

$$\pi^p = \sum_{m \epsilon t} \max\left[\frac{NDVI^* - NDVI_m}{NDVI^* - exit}, 0\right] \times c$$

where $exit$ is the minimum level of NDVI that will allow insured household to receive 100% payout each month and c represents the cost to keep animal alive each month.

Actuarial fair premium per insured TLU for these contracts is equal to the expected indemnity payout. Insurance company will however add some premium multiple $x > 1$ to the commercial premium to cover other fixed, administrative costs. Total premium per insured TLU is

$$\rho^i = xE(\pi^i) \ \ where \ \ i = r, p$$

As household needs to increase herd off-take to pay for insurance premium when the cost is beyond the milk production income, we can write the optimal herd accumulation dynamics with asset protection insurance insuring H^p unit of herd as

$$H_{t+1} = \left(1 + b_{t+1} - m_{t+1}\right)\left(H_t - \left(\frac{\bar{c} + \rho^p H^p - p_t^m m(H_t)}{p_t^h}\right)\right) + \delta(\pi^p)H^p$$

where $\delta(\pi^p)H^p$ reflects the amount of insured herd that household could be able to save using asset protection's early indemnity payout. And so $\delta(\pi^p)$ reflects the effectiveness of early intervention, made possible through early indemnity payout π^p, in keeping insured herd survived from drought-related mortality.

If $\delta(\pi^p) = m(NDVI_t)$, early intervention would be very effective in keeping all insured herd survived from drought-induced mortality. If $\delta(\pi^p) = \max[m(NDVI_t) - m^*, 0]$, asset protection contract would thus make equivalent payout as the comparable asset replacement contract. And if this effective early intervention can be achieved with comparable payout frequency and intensity, asset protection insurance would be cheaper and so more cost effective relative to the asset replacement counterpart.

Basis risk: Note that both livestock insurance are written NDVI not actual mortality rate. Basis risk – when indemnity payment deviates from or could not allow household to save their individual herd losses – would exist. The value to farmers will thus depend on the how closely individual herd mortality tracks that of $m(NDVI_t)$ especially for the case of asset replacement and so insurance will be valuable to pastoral household as $r_{m_t, m(NDVI_t)} \rightarrow 1$. Basis risk of asset protection contract would depend on a nontrivial reactions between (i) how accurate NDVI series are in triggering effective early drought intervention and (ii) how effective the

5. Public supports

We assume that public support could result in $s\%$ reduction in insurance premium rate (the free provision of macro-level asset protection will have $s = 100\%$) and will cover up to a pre-specified herd size. Total public cost per household i is thus

$$S = s\rho H_i$$

B. Calibrating economic model with actual data

Livestock production

1) Sub-location and division seasonal livestock mortality (%) and livestock price
$f(m_t, m(NDVI_t), p_t^h) \sim N(\mu_{m_t}, \mu_{m(NDVI_t)}, \mu_{p_t^h}, \sigma_{m_t}, \sigma_{m(NDVI_t)}, \sigma_{p_t^h}, r\ \ )$

- Sub-location mortality m_t: $\mu = 0.11$, $\sigma = 0.15$
- NDVI Predicted division averaged livestock mortality $m(NDVI_t)$: $\mu = 0.11$, $\sigma = 0.13$
- Division averaged TLU price (KSh): $\mu = 19{,}843$, $\sigma = 5{,}981$
- Common correlation matrices for the three variables

	Sub-location	Division	Livestock price
Sub-location	1		
Division	0.5	1	
Livestock price	-0.4	-0.2	1

Our analysis was done on a representative pastoral household at the sub-location level with the assumption that perfect risk sharing exist at the sub-location level. Sub-location average yields were thus used to represent mortality of our representative household.

Long-term mean and standard deviation of the NDVI Predicted division averaged livestock mortality were obtained from ILRI's constructed mortality indices used to underwrite their asset replacement contract. The series were constructed for each and every division in the 4 HSNP counties from 1982-2013. Long-term mean and standard deviation of the sub-district averaged seasonal mortality rates and division averaged livestock prices were obtained from 2005-2012 household survey data collected by Arid Land Resource Management Project (ALRMP) in all 4 counties.

2) Milk price (KSh/liter): $p_t^m = 49$

Mean inflation adjusted milk price obtained from 1999-2012 ALRMP household survey data in all 4 counties.

3) Milk production (liter/season): $m(H_t) = \%\, milking\ animal\ \times averaged\ milk\ produced/TLU/day \times 180 \times TLU$=$0.28 \times 1 \times 180 \times TLU$
Parameters obtained from ILRI's index-based livestock insurance impact evaluation household survey in Marsabit, 2009-2012.
4) Natural herd growth rate (% per season): $b_t = 0.2$
Obtained from ILRI's index-based livestock insurance impact evaluation household survey in Marsabit, 2009-2012.
5) Herd distribution (TLU): H_t obtained from HSNP impact evaluation household survey 2009-2012 in all the four counties.

NDVI index based livestock insurance

6) Index: our analysis considered the impact of asset replacement that triggers monthly payout based on monthly NDVI. Since the actual design of monthly trigger is still in progress, we assume that this asset protection contract triggers payout based on ILRI's predicted livestock mortality index
7) Coverage level: when predicted livestock mortality index is above 15% similar to ILRI's product
8) Sum insured (KSh/TLU/season): $c = 4500$
Based on discussion with some officials at the MALF, we estimate based on the recent droughts experience in Wajir, Taita and Laikipia that it would cost 25 KSh per day to keep 1 TLU alive during drought.
9) Pure premium rate = 9% per year
10) Premium multiple (% of fair rate): $x = 200\%$. This is common rule of thumb in the industry
11) Effectiveness of asset protection in reducing livestock mortality: $\delta(\pi^p) = \max[m(NDVI_t) - 15\%, 0]$

We assume that monthly insurance payouts could allow for effective early interventions, which enable the insured pastoralist to perfectly avert all the predicted drought-related mortality beyond 15% of insured livestock.

12) Minimum subsistent consumption: $\bar{c}$ is assumed at 30% of annual food poverty line of a representative farming household with 4.7 adult equivalent members (according to the HSNP household survey data) calculated at national food poverty line of rural regions at KSh 988 per month per adult equivalent.
13) Government supports represented as premium reduction (%): $s = 100\%, 50\%, 25\%$

C. Simulations

We took the following steps to simulate key outcome indicators:

1) In order to describe the joint distributions of the seasonal sub-location averaged livestock mortality rates, NDVI predicted division averaged livestock mortality rates and division average TLU prices, we first computed their long-term means, standard deviations and correlation matrices of the deviation of mortality rates from their location-specific long-term means. These statistics were calculated using variations over the 16 seasons from 2005-2012, when ALRMP and ILRI's index overlap.
2) We then simulated, 100 replicates of 100 years series of these three levels of area yields assuming that their joint distribution follows 3-variable truncated multivariate normal distribution with means, standard deviations and correlation matrices obtained above.
3) For each simulated year in each replicate, we estimated key outcome variables for 4 level of starting herd sizes: 5 TLU, 10 TLU, 20 TLU and 40 TLU.
4) Finally, we calibrated our economic model using empirical data and estimated 100 replicates of 100-year series of key outcome variables of the representative households in the scenarios with and without insurance and across government supports.

Summary statistics of pastoral households in 4 HSNP counties

	Mean	SD	Mandera	Marsabit	Turkana	Wajir
Socioeconomics*						
Household member (adult equivalent)	4.7	1.8	4.7	4.5	4.5	5.2757
Monthly consumption expenditure/adult eq.	1746	789	2133	1363	1346	2202
Poverty headcount (2005 National poverty line)	47%		18%	72%	73%	20%
% with seasonal food shortage	60%		33%	45%	78%	71%
% receiving food aid	71%		69%	91%	51%	72%
Main Source of Income						
Livestock production (rearing, sale of livestock/product)	47%		41%	54%	41%	53%
Casual Labor	17%		29%	18%	3%	19%
Employment/Salary	2%		4%	3%	0%	1%
Business and Trade	6%		3%	4%	7%	8%
Petty trade	18%		12%	5%	42%	13%
Remittances and gifts	8%		9%	14%	4%	5%
Statistics by income quartile			Q1	Q2	Q3	Q4
% households who own livestock	89%		78%	89%	96%	93%
% engage in livestock production	51%		61%	59%	54%	31%
% share of livestock in total economic income	68%		63%	67%	74%	68%
Mean number of livestock owned by household (TLU)	10.5	14.9	5.1	9.0	11.4	14.8

Livestock production**	Mean	SD	Mandera	Marsabit	Turkana	Wajir
Herd size	10.4	14.9	11.5	11.7	9.0	11.6
Herd composition						
% Cattle	23%	19%	33%	36%	14%	42%
% Camel	18%	0%	44%	36%	30%	43%
% Smallstock	15%	0%	23%	28%	56%	15%
% Milking animal	28%	18%				
*Livestock mortality and price statistics***						
Sub-location TLU mortality (%)	0.15	0.18	0.18	0.09	0.14	0.12
S.D.			0.20	0.13	0.14	0.17
Division NDVI-predicted TLU mortality (%)	0.15	0.11	0.20	0.10	0.18	0.11
S.D.			0.09	0.14	0.08	0.11
Division averaged TLU price (KSh/TLU)	19,844	5,981	18,075	20,412	19129	24,448
Division averaged milk price (KSh/liter)	49	17	51	56	48	45

* From Hunger Safety Net Programme (HSNP) Impact Evaluation 2009-2012 panel household survey in 4 counties.
** From Arid Land Resource Management Project (ALRMP) Monthly Drought Monitoring Survey 1999-2012 in 4 counties
Milk and livestock prices are inflation adjusted using 2013 as base year

ANNEX C.1. ASSUMPTIONS AND PARAMETERS FOR FISCAL COSTING SCENARIOS FOR CROPS

The fiscal analysis presented in Section 4 is based on maize and wheat annual production data at district level provided by the State Department of Agriculture. The administrative classification refers to the 73 "pre-2012" districts (see **Table 10** for the list of districts). In such a data set the number of observations per district is quite heterogeneous and there are many gaps. For the case of maize, complete series ranging from 1983 to 2012 are available for only 50% of the districts; while for the rest of the districts the series are shorter, including cases in which there are as few as 6 observations. However, for all of the 15 districts that account for over 50% of the maize cultivated area the time series are acceptably long and start at the latest in the mid '90s. One significant limitation of the maize data set is that it is composed of annual yield values which do not allow to account for yield variability in the biannual production areas. While this is a significant limitation for the product design to be carried out in a potential implementation phase, from a fiscal analysis perspective the data can still provide the basis for identifying initial rough operational estimates of the fiscal costs.

The data for wheat also shows many gaps and, unfortunately, data is missing for 2008 and 2009, years known to have been critical for wheat production (2009 in particular). The fact that the gaps are recorded in recent and sensitive years has a significant impact on the quality of the simulations. Compared to maize, the wheat data set is relatively smaller as 95% of cultivated area is concentrated in 5 districts only (Meru Central, Lakipia, Narok, Nakuru, Uasin Gishu). Given that wheat production in other districts is sparse and of low quality, the analysis has focused only the 5 main production districts.

As both the maize and wheat series presented data reporting issues (e.g. confusions between metric tons, kg, and bags), when obvious compiling mistakes were showing data were revised and corrected.

The assumptions adopted in the analysis are the following.

- The reference figures for cultivated area are equivalent to the average of the latest 5 years available. For yields, reference is made to the average yield recorded in the period 2008 – 2012 for maize, and in the period 2011 – 2012 for wheat (data for the 2008-2010 campaigns was mostly not available).
- Yield data has been detrended with respect to a trend reference composed by an average of linear, exponential and moving average trends.
- The price at which maize and wheat production have been valued is 34 KSh/kg for maize and 46 KSh/kg.
- The coverage level was set at 80%.

- Progressively increasing insurance take up has been projected by starting at 3% at the beginning of the program in 2016, and reaching 15% for maize and 25% for wheat in 2023.
- The number of farmers involved in the program has been estimated by dividing the projected cultivated area by the median farm size, respectively 1.5 ha for maize and 3.0 ha for wheat. The reason for selecting the median, and not the average, is linked to the possible introduction of caps in the number of hectares per farm insured under the supported program. In addition, for maize, the biannual production pattern in 75% of cultivated area has been accounted for by dividing the estimated number of farmers by 1.6, also considering that in the biannual production regions cultivated area may be lower in the less favorable season.

As mentioned in the Crop Insurance Section, the fiscal scenarios include the provision of public support for additional data collection activities that should complement the GoK procedures for estimating production and area data operated at County level. Although many different arrangement can be envisioned, including the possibility of outsourcing some functions to the private sector, the assumption adopted in the present analysis is that the additional Crop Cutting Experiments (CCEs) required would be carried out by the public extension service.[44] Hence, in terms of costing, the GoK will cover expenses for equipment, labor, management and auditing costs. The calculations that lead to the estimation of the supplementary data collection costs are presented in **Table 12**. For simplicity, reference is made to an area of 10km x 10km (10,000 hectares) for which a hypothetical number of 10 additional CCEs would be foreseen. It is estimated that a team of 2 people can carry out 4 CCE per day and that a man-day salary for such an activity could be set at KSh 2500. The cost of the supplementary CCE activity is obviously a function of the area to be covered. In this respect it should be noted that while in the beginning the CCEs can be carried out in the areas where the AYII programs are piloted, if the programs are to expand significantly, all the areas should be surveyed and yield databases developed. This is why, despite the fact that the projected penetration of AYII in 2022 is set at 15% for maize and at 25% for wheat, the area covered by the extra CC should be 100%. In order to account for equipment, management and auditing costs an approximated overhead of 50% has been added onto the cost of carrying out the CCEs.

[44] This leads to a conservative cost estimate, in particular if compared to situations in which CCEs would have to be outsourced to a private entity and extension officers would mainly have an auditing function.

TABLE 10: YIELD, AREA AND PREMIUM RATE DATA FOR MAIZE

	Province	District	YIELD (kg/ha) Avg '08-'12	CULTIVATED AREA (ha) Avg '08-'12	PURE RISK PREMIUM RATE x DISTRICT	CAPPED INSURANCE PREMIUM RATE x DISTRICT
1	Central	Thika	N.A	N.A.	N.A	N.A.
2	Central	Kiambu East	1442	4,778	6.6%	13.2%
3	Central	Kiambu West	N.A	N.A.	N.A	N.A.
4	Central	Kirinyaga	1108	20,671	8.4%	15.0%
5	Central	Murang'a North	697	19,508	10.8%	15.0%
6	Central	Murang'a South	1443	30,085	8.6%	15.0%
7	Central	Nyandarua North	2038	8,892	6.3%	12.6%
8	Central	Nyandarua South	2152	2,171	N.A	N.A.
9	Central	Nyeri South	741	13,332	7.5%	14.9%
10	Central	Nyeri North	N.A	N.A.	N.A	N.A.
11	Coast	Taita Taveta	880	16,599	12.8%	15.0%
12	Coast	Kwale	1265	45,120	5.5%	10.9%
13	Coast	T/River	1484	8,893	6.7%	13.5%
14	Coast	Mombasa	777	1,264	8.5%	15.0%
15	Coast	Lamu	1890	18,065	6.1%	12.2%
16	Coast	Malindi	970	15,853	4.8%	9.5%
17	Coast	Kilifi	885	52,811	4.9%	9.9%
18	Eastern	Embu	1390	19,722	6.4%	12.8%
19	Eastern	Isiolo	543	736	1.8%	3.5%
20	Eastern	Kitui	700	43,463	14.9%	15.0%
21	Eastern	Machakos	713	140,485	15.6%	15.0%
22	Eastern	Makueni	640	95,984	12.0%	15.0%
23	Eastern	Marsabit	N.A	N.A.	N.A	N.A.
24	Eastern	Mbeere	709	26,326	3.1%	6.2%
25	Eastern	Meru central	1739	37,104	10.0%	15.0%
26	Eastern	Meru North	1519	59,291	4.7%	9.3%
27	Eastern	Meru South	1405	15,262	7.8%	15.0%
28	Eastern	Moyale	299	456	1.8%	3.5%
29	Eastern	Mwingi	514	37,160	15.1%	15.0%
30	Eastern	Tharaka	1135	12,033	10.7%	15.0%
31	North Eastern	Ijara	128	145	1.8%	3.5%
32	North Eastern	Garrisa	580	356	1.8%	3.5%
33	North Eastern	Wajir	222	785	1.8%	3.5%
34	North Eastern	Mandera	329	1,385	18.9%	15.0%
35	Nairobi	Nairobi	N.A	N.A.	N.A	N.A.
36	Nyanza	Bondo	1134	19,921	13.5%	15.0%
37	Nyanza	Gucha	2240	17,894	4.4%	8.7%
38	Nyanza	H/Bay	1429	41,438	1.8%	3.5%
39	Nyanza	Kisii	2258	37,678	1.8%	3.5%
40	Nyanza	Kisumu	1394	18,140	1.9%	3.8%
41	Nyanza	Kuria	2277	13,533	2.9%	5.9%
42	Nyanza	Migori	1515	56,209	1.8%	3.5%
43	Nyanza	Nyamira	2019	61,632	1.8%	3.5%
44	Nyanza	Nyando	1502	9,243	1.8%	3.5%
45	Nyanza	Rachuoyo	1432	15,220	1.8%	3.5%
46	Nyanza	Siaya	1316	35,740	3.0%	6.0%
47	Nyanza	Suba	1263	7,569	2.2%	4.3%
48	Rift Valley	Baringo	1848	18,593	7.4%	14.7%
49	Rift Valley	Bomet	1938	34,234	8.4%	15.0%
50	Rift Valley	Bureti	2288	16,164	1.8%	3.5%
51	Rift Valley	Kajiado	1819	16,173	8.4%	15.0%
52	Rift Valley	Keiyo Marakwet	1696	39,364	9.4%	15.0%
53	Rift Valley	Kericho	2730	28,775	1.8%	3.5%
54	Rift Valley	Koibatek	1748	10,021	4.0%	8.1%
55	Rift Valley	Laikipia	2068	31,902	4.3%	8.6%
56	Rift Valley	Marakwet	2829	17,592	2.8%	5.5%
57	Rift Valley	Nakuru	2183	71,375	9.9%	15.0%
58	Rift Valley	Nandi	2768	77,603	1.8%	3.5%
59	Rift Valley	Narok	1849	38,884	12.3%	15.0%
60	Rift Valley	Samburu	1649	795	1.8%	3.5%
61	Rift Valley	T/Mara	3070	60,325	4.8%	9.5%
62	Rift Valley	T/Nzoia	3829	101,272	5.3%	10.6%
63	Rift Valley	Turkana	1319	1,631	3.7%	7.3%
64	Rift Valley	U/Gishu	3588	86,650	1.8%	3.5%
65	Rift Valley	W/Pokot	2068	23,416	4.7%	9.4%
66	Western	Bungoma	2529	79,872	1.8%	3.5%
67	Western	Busia	1219	30,416	1.8%	3.5%
68	Western	Butere	1899	4,366	1.8%	3.5%
69	Western	Kakamenga	2026	50,140	2.3%	4.5%
70	Western	Lugari	2921	19,359	1.8%	3.5%
71	Western	Mt. Elgon	2969	15,718	2.6%	5.2%
72	Western	Teso	1255	7,930	1.8%	3.5%
73	Western	Vihiga	1217	33,513	3.1%	6.3%

TABLE 11: YIELD, AREA AND PREMIUM RATE DATA FOR WHEAT

	Province	District	YIELD (kg/ha) Avg last 5 years available	CULTIVATED AREA (ha) Avg '11-'12	PURE RISK PREMIUM RATE x DISTRICT	CAPPED INSURANCE PREMIUM RATE x DISTRICT
1	Eastern	Meru central	2264	16,078	12%	15%
2	Rift Valley	Laikipia	2178	5,468	3%	5%
3	Rift Valley	Nakuru	2850	26,111	6%	11%
4	Rift Valley	Narok	2681	49,982	10%	15%
5	Rift Valley	U/Gishu	2703	29,668	2%	3%

TABLE 12: ESTIMATION OF POTENTIAL COST OF ADDITIONAL DATA COLLECTION ACTIVITIES FOR AYII

No of hectares in an area of 10km x 10km	10,000							
Number of CCEs per 10km x 10km area	10							
Number of people on a CCE team	2							
Number of CCEs carried out in a day by a CCE team	4							
Number of man-days needed to cover each 10,000 ha	5.0							
Man-day cost in Ksh	2500							
Cost of labor in KSh for each 10,000 ha	12500							
MAIZE: Reference total cultivated area	2,050,571							
WHEAT: Reference total cultivated area	127,306							
Share of area covered by additional CCEs	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***	***2021***	***2022***
	5%	15%	30%	45%	60%	75%	90%	100%
Overhead for equipment, management, auditing, etc.	50%	50%	50%	50%	50%	50%	50%	50%
MAIZE: Additional costs of yield data collection (million KSh)	***0.192***	***0.577***	***1.153***	***1.730***	***2.307***	***2.884***	***3.460***	***3.845***
WHEAT: Additional costs of yield data collection (million KSh)	***0.012***	***0.036***	***0.072***	***0.107***	***0.143***	***0.179***	***0.215***	***0.239***

A. A simple economic model

6. **Crop production:**
   Consider a one period model in key crop regions with many farmers. Each period, farmer 's crop production yields y_i kilograms per hectare of land and can enjoy total income of $y_i p_i$ KSh per hectare of cultivated land, where p_i is the crop price per kilogram.
   At the beginning of each season, farmers are credit constrained and so needs to take out loan L KSh to purchase inputs, e.g., seeds and fertilizer. He then pays back at the end of the harvest with crop income.
7. **Risk:**
   Both crop price and yield are uncertain. Crop price p_i is assumed to follow a uniform distribution, $U(p_l, p_h)$. Crop production also faces various kinds of risk including both farm-specific risk, e.g., disease or illness of farm labor, as well as the covariate risk, e.g., droughts and floods that tend to affect all farmers in the area. With the presence of common covariate shocks, we should thus expect individual crop yields to track average yields in their area to some extent.
   In order to understand this empirical relationship, we describe joint distribution of individual yield y_i and the average yield across all farmers in the area $\bar{y}$ with a bivariate normal distribution:

$$f(y_i, \bar{y}) \sim N(\mu_{y_i}, \mu_{\bar{y}}, \sigma_{y_i}, \sigma_{\bar{y}}, r_{y_i,\bar{y}})$$

   where $\mu_{y_i}, \mu_{\bar{y}}$ represent long-term average levels of individual and area-averaged crop yields, $\sigma_{y_i}, \sigma_{\bar{y}}$ describe long-term standard deviations of the two yield series and $r_{y_i,\bar{y}}$ represents correlations of the two series observed in the empirical data. In the areas with large exposure fo common covariate shocks, we should expect individual yields to move together with the area-averaged yield and thus $r_{y_i,\bar{y}} \rightarrow 1$. On the other hand, when farm-specific shocks dominate the covariate ones, $r_{y_i,\bar{y}}$ will deviate largely from one.
8. **Area yield index insurance (AYII):**
   The contract is designed to protect farmers from covariate shocks that could affect all farmers in the area and that are not effectively managed by existing 'mutual risk sharing mechanisms' within the community. Specifically, AYII compensates insured farmer at an expected crop price p per kilogram when area averaged yield $\bar{y}$ falls below a pre-specified coverage level y^*. Indemnity payout per insured hectare can thus be written as

$$\pi = \max[0, y^* - \bar{y}] \times p$$

   where the coverage level is set as some percentage of the expected area yield, i.e., $y^* = coverage \times \mu_{\bar{y}}$.

   Actuarial fair premium per insured hectare for this contract is equal to the expected indemnity payout. Insurance company will however add some premium multiple $x > 1$ to the commercial premium to cover other fixed, administrative costs. Total premium per insured hectare can be written as

$$\rho = xE(\pi)$$

With AYII offering protection of income shortfall from area yield variability, farmer's insured crop income per hectare can thus be $y_i p_i + \pi - \rho$.

Basis risk: Note that insurance is written on area yield, not individual yield. While this resolves asymmetric information and reduces transaction cost, it also could limit the value of insurance to individual farmers with the presence of basis risk – when indemnity payment deviates from individual losses. The value to farmers will thus depend on the how closely individual yield tracks that of area average. AYII will be valuable to farmer as $r_{y_i,\bar{y}} \rightarrow 1$.

9. Loan repayment:

Input credit is obtained at the interest rate r. And so if farmer always pay back their loan as much as possible using crop income, net income available for consumption for farmer i who cultivate a median farm size A_i hectares of maize will be

$$C_i = (y_i p_i + \pi - \rho - (1 + r)L) \times A_i$$

Loan default is however possible and can be partial or total. While full repayment is an option, we more realistically assume that farmer will try to payback their loan as much as they can after meeting their subsistent consumption $\bar{c}$ (set at 30% of food poverty line).[45] Farmer 's loan repayment will be

$$LR_i = \max[(1 + r)L, y_i p_i + \pi - \rho - \bar{c}] \times A_i$$

10. Public supports

We assume that public support could result in s% reduction in insurance premium rate and will cover the whole cultivated farm of representative farmer. Total public cost per farmer i is thus

$$S = s\rho A_i$$

Cost/benefit analysis of public support to agricultural insurance program was analyzed with the working assumption that in the very first years, developing of insurance program would only be possible with public support and one of the key policy objectives is to reduce poverty among smallholder farmers. We then computed KSh cost per farming household per year that can reduce 1% poverty rate (based on national food poverty line, 2005) relative to the baseline without the program in these production zones. Direct cash transfer program to the poor was further used as counterfactual program for cost/benefit analysis. And so the KSh cost per farming household per year that can reduce 1% poverty rate was commuted as (poverty gap×poverty line)/poverty rate.

11. Values of AYII

- *Value to farmers*: AYII reduces vulnerability by providing buffer against sharp drop of net crop income available for consumption in the event of severe shocks
- *Value to lenders*: Based on our assumption that farmers will try to pay back loan after meeting required consumption, AYII thus will increase loan repayment rate on average. To make this assumption more realistic, lenders can make insurance a pre-requisite for obtaining loan and/or link insurance with loan directly. With increasing loan repayment, lenders could eventually be willing to extend more credit to farmers.
- *Potential crowding in value of AYII through credit market*: In the medium term, insurance could enhance agricultural productivity by promoting smallholder farmer's adoption of productive inputs, e.g., new technology, hybrid seeds. This could be true when AYII relaxes demand-side constraint (i.e.,

[45] This should capture the important feature from reality that farmers will not give away everything in order to repay the loans. They would rather satisfy their basic needs before relaying any loan.

enhancing farmer's investment incentives and credit demand when agricultural production is de-risked) as well as supply-side constrain (i.e., allow lenders to increase credit supply to farmers). Farmer i's net income available for consumption when AYII unlock access to credit allowing him to afford more expensive but productive input with yield mark up $\alpha_y > 1$ per hectare and higher cost (and larger loan size) relative to the current required level with mark up of $\alpha_L > 1$:

$$C_i^h = \left(\alpha_y(y_i p_i + \pi - \rho) - \alpha_L(1+r)L\right) \times A_i$$

12. Calibrating economic model with actual data

Crop production

1) Sub-location, division and district yield (kg/ha): $f(y_i, \bar{y}) \sim N(\mu_{y_i}, \mu_{\bar{y}}, \sigma_{y_i}, \sigma_{\bar{y}}, r_{y_i,\bar{y}})$ with $\mu_{subl} = \mu_{div} = \mu_{dist} = \mu$ and $\sigma_{subl} = \sigma_{div} = \sigma_{dist} = \sigma$
   - Low potential maize zone: $\mu = 703, \sigma = 347$
   - Med potential maize zone: $\mu = 1426, \sigma = 414$
   - Low potential maize zone: $\mu = 2892, \sigma = 991$
   - Wheat: $\mu = 2505, \sigma = 881$
   - Common correlation matrices for all zones

	Sub-location	Division	Division
Sub-location	1		
Division	0.85	1	
District	0.75	0.81	1

Our analysis was done on a representative farmer at the sub-location level with the assumption that perfect income risk sharing exist at the sub-location level. Sub-location average yields were thus used to represent yields of our representative farmer.

Mean and standard deviations obtained from de-trended annual district yields are from the Ministry of Agriculture from 1983-2013. [46] Correlation metric obtained from 2-year Tegemeo panel household survey in 2000 and 2004. Survey covers 15-60 representative households in representative sub-locations, locations, divisions and districts in all production zones. Sample size varies by relative populations. Districts selected for analysis in all zones are those with large maize and crop growing areas with available data in both Tegemeo's household survey and district-level yield data.[47]

[46] Longitudinal district yield data were de-trended assuming an average combination of linear, exponential and moving average trend (Stutley's method). We also use estimated trends in this longitudinal data to also de-trend the two-year yield data.

[47] Districts considered in low potential maize zone include Kitui, Machakos and Makueni in Eastern province and Muranga, Kirinyaga and Nyeri in Central province. Districts in medium potential maize zone include Kisumu, Siaya, Nyamira in Nyanza province, Vihiga, Busia in Western province and Meru in Eastern province.

2) Producer price (KSh/kg): $p_i \sim U(p_l, p_h)$
   - Maize: $p_l = 22.7, p_l = 45.5$
   - Wheat: $p_l = 34.9, p_l = 58.1$

Country-level average maize producer prices (1991-2011) obtained from FAOSTAT and 2012-2013 from Regional Agricultural Trade Intelligence Network (RATIN). Prices were inflation adjusted with 2013 as base year.

3) Working capital loan (% of expected revenue): $L_i = 60\%\mu_{\bar{y}}\bar{P}$
From gross margin studies (KARI 2009, etc.), total input costs range from 50-75% of average crop revenue. This figure was also similar to total working capital loan reported in Tegemeo household survey. 60% is the median level.

4) Yield and cost markup rates with respect to high-cost, more productive input invested (% of expected yield and cost): α_y, α_L vary across crops and production zones. They were estimated from the ratio of yields and costs of high vs. low input crop productions of 3-5 representative small-scaled farmers with less than 4 hectares of land in some key growing provinces in each zone. Maize data were derived from KARI (2009)'s Assessment of Costs of Maize Production, Marketing and Processing in Kenya: A Maize Grain-Maize Meal Value Chain Analysis. Wheat data were obtained from DASS (2010)'s Gross Margin Analysis.

Crop zone	Studied county	Mark up (% of average)	
		Yield	Production cost
Low potential maize	Machakos, Eastern	233%	308%
Med potential maize	Kirinyaga, Central	182%	138%
High potential maize	Laguri, Western	200%	123%
	Narok, Rift Valley	193%	129%
	Mean	196%	126%
Wheat	Narok, Rift Valley	139%	132%
	Nakuru, Rift Valley	139%	133%
	Mean	139%	133%

5) Farm size (hectare): $A_{ilow} = A_{imedium} = 1.5, A_{ihigh} = 2.5, A_{iwheat} = 3$
This was obtained from Tegemeo household survey.

Area yield index insurance (AYII)

6) Indices: $\bar{y}$, we constructed both division and district average yields, as the goal was also to evaluate the AYII with these two different indices.
7) Premium multiple (% of fair rate): $x = 200\%$. This is common rule of thumb in the industry
8) Coverage level:

Zone	High coverage (15% maximum rate)	Low coverage (10% maximum rate)

Districts considered in high potential maize zone are Nakuru, T/Mara, T/Nzoia, U/Gishu in Rift Valley province and Bungoma and Kakamenga in Western province.

	Coverage	Fair premium	Coverage	Fair premium
Low maize	50%	7.30%	30%	4.50%
Medium maize	85%	6.60%	75%	4.20%
High maize	80%	7.40%	65%	4.20%
Wheat	75%	6.60%	65%	4.50%

9) Interest rate on working capital loan (% per year): $r = 17\%$
   Weighted average commercial bank lending rate as of April 2014 obtained from FSD
10) Minimum subsistent consumption: $\bar{c}$ is assumed at 30% of annual food poverty line of a representative farming household with 5 adult equivalent members (statistics from Tegemeo survey) calculated at national food poverty line of rural regions at KSh 988 per month per adult equivalent.
11) Public supports represented as premium reduction (%): $s = 50\%$

13. Simulations

We took the following steps to simulate key outcome indicators and zone-specific longitudinal series of representative and area yields and prices from their joint distribution:

5) Using the 2-year Tegemeo household data, we constructed 2 years of annual area-average yields at sub-location, division and district level by averaging individual yields across households in each area in each year.
6) In order to describe the zone-specific joint distributions of the three levels of yields, we computed zone-specific means, standard deviations and correlation matrices of sub-location, division and district yields. These statistics were calculated using variations over the two years and across respective area yields within each zone.[48]
7) The relatively short temporal coverage of household data could result in underestimation of temporal variations of these series. We thus complemented this data with longitudinal de-trended district-level yield data and computed zone-specific moments. While means of these three-level of area yields were comparable within each zone, standard deviations were a lot smaller in the two years data. Means and standard deviations of these sub-location, division and district yield series in each zone were then assumed to be similar to that estimated from the 1983-2013 district yield series.
8) Fourth, we simulated for each production zone, 100 replicates of 100 years series of these three levels of area yields assuming that their joint distribution follows 3-variable multivariate normal distribution with zone-specific means and standard deviations obtained from 1983-2013 district yield data and correlation matrices obtained from the variations within the two years household data.

[48] Because our temporal coverage was limited and could results in underestimation of actual temporal variations, we decided to exploit spatial variations of the area yield within each zone as well with the assumption that variations of area yields within each homogenous zones can be good representation of variations of yield realizations over time in that zone.

9) For each simulated year in each replicate, we also randomly draw one price realization from a uniform distribution specified with 10-year minimum and maximum national aggregate, inflation adjusted price observed empirically from 1991-2013.
10) Finally, we calibrated our economic model using empirical data and estimated 100 replicates of 100-year series of key outcome variables of the representative farmer in each zone in the scenarios with and without AYII and across contract variations.

TABLE 13: SUMMARY STATISTICS OF MAIZE AND WHEAT GROWING HOUSEHOLDS

	Mean	Median	SD	Min	Max
Household member (adult equivalent)**	5.2	5.1	1.9	0.6	13.2
Poverty headcount (national rural poverty line (2005))**	41.5%				
Yield and price statistics*					
Maize in low potential zone (kg/ha)	703	671	347	18	2,085
Maize in medium potential zone (kg/ha)	1,426	1,342	414	159	3,165
Maize in high potential zone (kg/ha)	2,892	2,790	991	397	5,325
Wheat (kg/ha)	2,505	2,617	881	26	4,581
Aggregated maize price (Ksh/kg)	34	34	7	23	45
Aggregated wheat price (Ksh/kg)	46	45	8	35	58
Maize producing households**					
Cultivated land size (ha)	2.5	1.5	4.5	0.1	110.0
Low potential zone	2.2	1.5	2.9	0.1	21.0
Medium potential zone	1.7	1.5	1.6	0.1	11.5
High potential zone	2.9	2.5	6.0	0.1	110.0
% households who own land	52%	67%	48%	0%	100%
% with two croping seasons a year	42%	39%	38%	0%	100%
% use purchased hybrid seed	23%	19%	33%	0%	100%
% households with maize sale	18%	0%	27%	0%	100%
Low potential zone	8%	0%	18%	0%	100%
Medium potential zone	7%	0%	17%	0%	100%
High potential zone	28%	20%	31%	0%	100%
% maize income from total econ income	29%	23%	20%	3%	100%
Low potential zone	70%	70%	10%	50%	100%
Medium potential zone	28%	31%	20%	3%	100%
High potential zone	28%	23%	20%	4%	100%
Wheat producing households**					
Cultivated land size (ha)	7.6	3.0	23.6	0.0	240.0
% households who own land	60%	100%	48%	0%	100%
% with two croping seasons a year	0%	0%	0%	0%	0%
% use purchased hybrid seed	26%				
% households with wheat sale	78%	90%	30%	0%	100%
% wheat income from total econ income	29%	23%	20%	0%	86%
Credit access***					
% households with input credit	46%	39%	14%	0%	100%
Purpose of credit					
Fertilizer	81%	79%	21%	0%	100%
Seed	9%	9%	41%	0%	100%
Other equipments	10%	3%	43%	0%	100%
Credit source					
AFC	1%	1%	6%	0%	14%
Commecial banks	1%	1%	3%	0%	8%
Cooperatives/Saccos	25%	39%	21%	0%	100%
Local trader/companies	10%	10%	14%	0%	100%
NGOs/MFIs	1%	1%	5%	0%	11%
Money lenders	2%	1%	32%	0%	100%
Friend/relatives, ROSCAs, etc.	6%	6%	26%	0%	100%
Lending rates****					
Commercial banks (5-yr statistics)	16%	15%	2%	14%	20%

* From 30 years detrended district-level yield data from 1983-2012 obtained from the Ministry of Agriculture
Inflation adjusted aggregated producer pricesFAOSTAT and Regional Agricultural Trade Intellegence Network
** Household data from 2000, 2004 household survey of Tegemeo Agricultural Monitoring and Policy Analysis Project
National rural poverty line is 1,562 KSh/capita/month
*** Data from Kenya Integrated Household Expenditure Survey 2005
****Monthly FSD data on commercial bank's weighted average lending rates from 2005-2014

TABLE 14: SUMMARY OF KEY IMPACT INDICATORS BY CONTRACT VARIATIONS

Impact indicators	No insurance	District-level yield index								Division-level yield index (with reduced basis risk)							
		High coverage				Low coverage				High coverage				Low coverage			
		Commercial AYII	50% subsidized AYII	Commercial AYII with increased investment	50% subsidized w/ increased investment	Commercial AYII	50% subsidized AYII	Commercial AYII with increased investment	50% subsidized w/ increased investment	Commercial AYII	50% subsidized AYII	Commercial AYII with increased investment	50% subsidized w/ increased investment	Commercial AYII	50% subsidized AYII	Commercial AYII with increased investment	50% subsidized w/ increased investment
Maize - Low potential zone																	
		Coverage = 50%, fair rate = 7.3%				**Coverage = 30%, fair rate = 4.5%**				**Coverage = 50%, fair rate = 7.3%**				**Coverage = 30%, fair rate = 4.5%**			
Net income available for consumption per year (Ksh).	10,721	9,408	10,721			10,234	10,721			9,402	10,717			10,227	10,717		
Std.Dev in parenthesis	(18,940)	(17,713)	(17,713)			(18,383)	(18,383)			(16,483)	(16,483)			(17,289)	(17,289)		
Probability of falling into poverty*	100%	100%	100%			100%	100%			100%	100%			100%	100%		
Loan repayment (%) after min. consumption	59%	56%	59%			58%	59%			55%	58%			57%	58%		
Maize - Medium potential zone																	
		Coverage = 85%, fair rate = 6.6%				**Coverage = 75%, fair rate = 4.2%**				**Coverage = 85%, fair rate = 6.6%**				**Coverage = 75%, fair rate = 4.2%**			
Net income available for consumption per year (Ksh).	21,723	17,647	21,723	54,342	61,753	19,447	21,723	57,615	61,753	17,652	21,733	54,346	61,766	19,450	21,733	57,615	61,766
Std.Dev in parenthesis	(25,840)	(23,250)	(23,250)	(41,500)	(41,500)	(24,075)	(24,075)	(43,210)	(43210)	(21,765)	(21,765)	(39,530)	(39,530)	(23,075)	(23,075)	(41,151)	(41,151)
Probability of falling into poverty	90%	95%	90%	60%	55%	90%	90%	60%	55%	95%	90%	60%	55%	95%	90%	60%	55%
Loan repayment (%) after min. consumption	84%	82%	86%	95%	97%	83%	85%	96%	97%	82%	86%	95%	97%	83%	85%	96%	97%
Maize - High potential zone																	
		Coverage = 80%, fair rate = 7.4%				**Coverage = 65%, fair rate = 4.2%**				**Coverage = 80%, fair rate = 7.4%**				**Coverage = 65%, fair rate = 4.2%**			
Net income available for consumption per year (Ksh).	73,582	58,965	73,582	237,515	266,227	66,847	73,582	252,999	266,227	58,952	73,579	237,492	266,224	66,837	73,579	252,980	266,224
Std.Dev in parenthesis	(99,641)	(85,534)	(85,534)	(168,014)	(168,014)	(92,757)	(92,757)	(180,753)	(180,753)	(84,314)	(84,314)	(154,653)	(154,653)	(90,487)	(90,487)	(178,876)	(178,876)
Probability of falling into poverty	45%	50%	45%	15%	10%	50%	50%	15%	10%	50%	45%	10%	5%	50%	50%	15%	10%
Loan repayment (%) after min. consumption	91%	90%	93%	98%	99%	91%	92%	98%	98%	91%	94%	98%	99%	92%	93%	99%	99%
Wheat																	
		Coverage = 75%, fair rate = 6.6%				**Coverage = 65%, fair rate = 4.5%**				**Coverage = 75%, fair rate = 6.6%**				**Coverage = 65%, fair rate = 4.5%**			
Net income available for consumption per year (Ksh).	104,466	87,274	104,466	169,047	194,750	94,179	104,466	179,372	194,750	87,271	104,462	169,044	194,745	94,185	104,462	179,380	194,745
Std.Dev in parenthesis	(136,714)	(117,954)	(117,954)	(176,345)	(176,345)	(125,404)	(125,404)	(185,782)	(185,782)	(111,404)	(111,404)	(173,571)	(173,571)	(123,509)	(123,509)	(183,904)	(183,904)
Probability of falling into poverty (%)	35%	40%	35%	30%	25%	40%	35%	30%	25%	40%	35%	30%	25%	40%	35%	30%	25%
Loan repayment (%) after min. consumption	92%	92%	94%	95%	96%	92%	94%	95%	96%	93%	95%	96%	97%	93%	94%	96%	96%

* At national food poverty line (2005) at KSh 988 per month per adult equivalent. For a representative household of 5 equivalent adults, food poverty line is calculated at 988*12*5 = Ksh 59,280 per year.