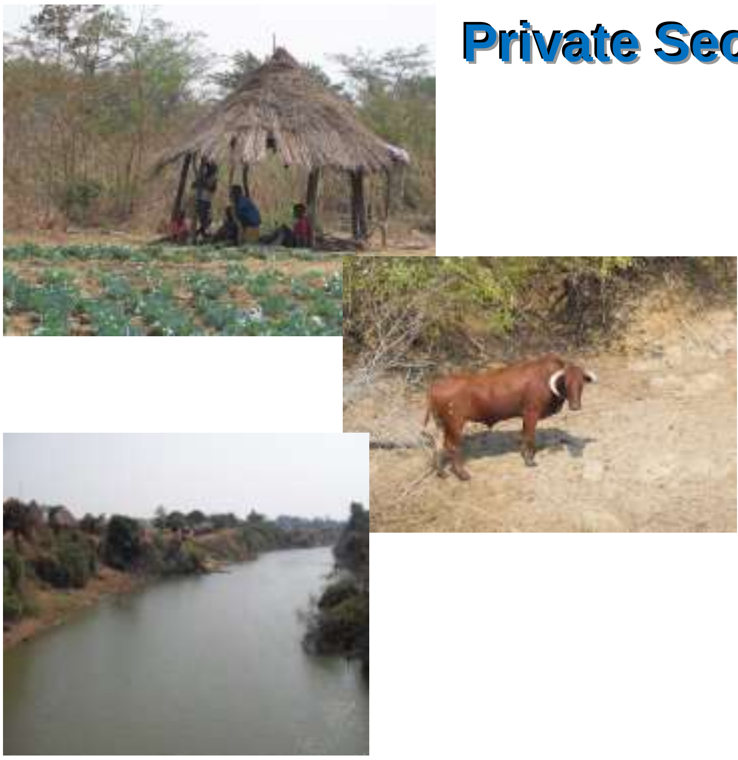

Private Sector Support to Climate Resilience in Zambia

Submitted to

International Finance Corporation
World Bank Group

For public release

Submitted By:

BASIX
Equity for Equity

Weather Risk WRL
Weathering Weather Securing Smiles

MICROENSURE
Helping the poor weather life's storms

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NB: Names of institutions, companies, projects and products in the report have been replaced with letters e.g. Company A, B, C or Product 1, 2 3 in order to maintain confidentiality of entities, projects and products involved.

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The report also draws on the various other relevant reports, by a range of experts / organizations, commissioned by different stakeholders and have been duly acknowledged wherever any reference is made to them.

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BASIX

Acronyms

AEZ	Agro Ecological Zone
AIC	Agriculture Insurance Company of India
AML	Anti-Money Laundering
CAIS	Canadian Agricultural Income Stabilization
CBPP	Contagious Bovine Pleuro Pneumonia
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CCS	Cooperative Credit Scheme
CEEPA	Center for Environmental Economics and Policy in Africa
CFT	Combating the Financing of Terrorism
COMESA	Common Market for Eastern and Southern Africa
CRMG	Commodity Risk Management Group
CSO	Central Statistical Office
DFID	Department for International Development
ENSO	El Niño–Southern Oscillation
ET	Evapo-transpiration
EUMETSTAT	European Organisation for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization
FGDs	Focus Group Discussions
FISP	Farm Input Supply Program
FONDEN	Fondo de Desastres Naturales
FRA	Food Reserve Agency
FSP/FISP	Farmer Input Support Programme
GDP	Gross Domestic Product
GIIF	Global Index Insurance Facility
HARITA	Horn of Africa Risk Transfer for Adapt-action
IAPRI	Indaba Agricultural Policy Research Institute
IBWI	Index Based Weather Insurance
IFC	International Finance Corporation
ILO	International Labour Organization
INR	Indian Rupee
IRDA	Insurance Regulatory and Development Authority, India
MCB	Maize Control Board
MCT	Ministry of Communications and Transport
MFIs	Micro Finance Institution
MPCI	Multi-Peril Crop Insurance
NAMBOARD	National Agricultural Marketing Board

NASA	National Aeronautics and Space Administration
NASFAM	Malawi's National Association of Small Farmers
NCMSL	National Collateral Management Services Limited
NGOs	Non-governmental organization
NMC	National Meteorological Center, US
PI	Production Insurance
PIA	Pensions and Insurance Agency
PSNP	Productive Safety Net Program
SAA	Secretaria de Agricultura e Abastecimento
SDC	Swiss Agency for Development and Cooperation
SPCR	Strategic Program on Climate Resilience
SRS	Satellite Remote Sensing
TRMM	Tropical Rainfall Measuring Mission
UNDP	United Nations Development Programme
USD	US Dollar
WB	World Bank
WBCIS	Weather Based Crop Insurance Scheme of India
WFP	World Food Program
WMO	World Meteorological Organization
WRMF	Weather Risk Management Facility
WRMS	Weather Risk Management Services
ZMD	Zambia Meteorological Department
ZMK	Zambian Kwacha
ZVAC	Zambia Vulnerability Assessment Committee

Executive Summary

Agricultural Weather Index Based Insurance (WII) is a sub-component of the transformational objectives of the Strategic Program on Climate Resilience (SPCR) for priority areas of the Barotse and Kafue sub-basins. This feasibility study develops a road map for design and implementation of a commercially sustainable index-based product for flood and drought risks in Zambia.

We consulted all relevant local stakeholders, including Insurance companies, Govt. Agencies, Outgrowers, Seed and Fertilizer companies, Banks, MFIs and the Regulator. We conducted 12 Focus Group Discussions (FGDs) and interviewed 385 farmers across the Kafue and Barotse river basins. The farmers were interviewed on issues like product design, willingness to pay, preferred distribution channels among other socio-economic aspects. We collected data from the Zambian Meteorological Department, Department of Agriculture and livestock and other sources.

We find Agricultural Weather Index Insurance (WII) is feasible and commercially viable because key conditions are in place:

i. **Demand:** strong farmer demand exists for risk covers such as deficit and excess rainfall, floods, high humidity and frost.

ii. **Supply**: Intermediaries such as Banks and MFIs, Out growers have a profit interest and/or risk mitigation interest in selling WII to farmers. They would launch and scale up WII by bundling these schemes with their other main line products and services. Several Insurers have expressed willingness to launch WII and have a distribution network of their own to market Crop Insurance Products.

iii. **Facilitators**: Government agencies, including the Meteorological Department, are willing to provide or facilitate the public goods needed to make a market for WII happen. Zambia also has reasonable historical weather data to price WII products. It helps that the present Multi-peril crop insurance scheme (MPCI) serves the interest of large farmers only and does not cater to the requirements of small and medium scale farmers. In addition, the regulator supports the launch of WII products in the interest of the smaller farmers.

However, there are a few areas of concern, in particular the lack of adequate density of the weather station network and the lack of technical know-how and capital among insurers. These two weaknesses would slow down the growth of WII in Zambia and threaten its commercial viability. Furthermore, we foresee low business volumes in the initial years, as a result of which reinsurance rates may be uncompetitive. Accessing historic weather data in Zambia seems to be difficult, as the Zambian Meteorological Department (ZMD) does not habitually provide daily weather data, unless there is a special agreement in place.

We propose IFC loans to weather data Third Party administrators to address the key weakness of inadequate weather data. These Third Party Administrators (TPAs) would set up weather monitoring infrastructure. IFC would provide soft loans or equity in the order of $US 1 million to those TPAs to expand the weather monitoring infrastructure (500-600 weather stations in Kafue and Barotse) in coordination with Zambia Meteorological Department (ZMD). The loans can be repaid in 6-7 years. The TPAs would also help local insurance companies in the design and development of index based insurance products and sell real time data to those insurers. TPAs would also sell weather information content to farmers and farmer extension service programs, helping farmers to better manage and reduce climate risk, which is in line with the PPCR objectives.

IFC can address the lack of WII know-how and capital and facilitate competitive reinsurance rates by setting up a WII capital fund. This fund could reinsure part of those index insurance contracts. The technical support to this fund can be provided through the IFC –GIIF facility or other capable fund managers. Insurers subscribing to this facility need to compulsorily provide covers if approached by growers. The fund can in turn reinsure itself with larger reinsurance companies. The profits from this fund will go back to IFC. These funds can be parked with a global reinsurer as a "captive company" and administered by IFC-GIIF or any other capable fund manager. A part of this fund can also be reserved for meeting future climate change related contingencies. The fund would need to be capitalized at around $US 1 million to cover premiums of about $ 100,000 per year; assuming that each contract is priced at 8-10% of the policy limit. There is substantial diversification in weather parameters, especially in rain, across locations in the two basins. If the insurers diversify well, then the fund required to cover the portfolio of contracts is much lower than the sum of the funds required to cover contracts on individual locations.

WII would cover around 50,000 farming households (6-7% of total no. of farming households) annually within 7 years. In order to achieve this public goods and therefore financial assistance to the tune of $US 2 million is required. The contributions of key stakeholders are as follows:

Institutions	Contribution	Time Period
IFC	Technical advisor to Insurance companies, Facilitate launch of Reinsurance fund, Provide soft loan to TPAs	7 years
Insurance companies	Can Include index insurance covers as part of their standard Crop Insurance (MPCI, Including Fire and theft) schemes. Need to Invest in sales and marketing of Index Insurance, and procurement of weather data for settlement of contracts	Need to be involved throughout the product life cycle
Government of Zambia	Subsidize premium of index insurance for small growers as safety net Improve the weather monitoring infrastructure Provide Access to FRA/FISP outreach,	Can subsidize the premiums for the first 7-10 years and then withdraw gradually
Out-growers/Banks/MFIS	Bundle Index Insurance as part of their incentive package to farmers	Need to be involved throughout the product life cycle
TPAs	Install 500-600 AWS in Zambia. Need to work in tandem with the Zambian Meteorological Department.	Need to be involved throughout the product life cycle

The Barotse region has a large number of small farmers who are likely to depend on some subsidy and therefore a pilot WII program will be too sensitive to support from the government. There are however, other regions where WII is commercially viable.

Regions in Zambia	Criteria	Other Remarks
Eastern Provinces	High % of cultivable land, presence of Out growers & MFI's, Good linkage with urban markets	90% of the Cotton production happens here, Non-Flood Risks which can be easily covered under Index Insurance
Southern Provinces	High % of cultivable land, present of Out growers MFIs, Out growers and good infrastructure, prosperous maize growers	Several horticulture projects coming up to cater to urban markets, Non-Flood Risks which can be easily covered under Index Insurance
Central Provinces	High % of cultivable land after Eastern and Southern Provinces, There are pockets where commercial agriculture happens and are well connected to urban centres.	Non-Flood Risks which can be easily covered under Index Insurance

Multilateral institutions like the Swiss Development Co-operation (SDC), UNDP, COMESA and ILO have been working in Zambia for the launch and scale up of Index Insurance. A co-ordinated approach among the agencies will help resolve the structural bottlenecks in the growth of index insurance market in Zambia and can reduce the payback period.

Next steps: Before embarking on an actual pilot, IFC should officially confirm from the Govt. of Zambia on the possible support the latter can extend to the WII pilot programs. While the govt. officials are inclined to support WII it may take a few years to translate the positive intentions into a firm policy framework. IFC should also approach the ZMD and design a framework of collaboration between ZMD and the third party administrator. While the Insurance regulator has no in-principle objection to the launch of WII in Zambia, it will be prudent to obtain their official approval of the product.

1 Index Based Insurance Models: Lessons Learnt

1.1 Introduction of Index Based Insurance

The spectrum of risks that affect the income of agricultural producers and agribusinesses is quite broad. One of the most pervasive production risks, weather, impacts all aspects of the agricultural supply chain. Even with the introduction of new crop varieties, production technology such as irrigation, and new management practices that offer the potential to increase yields and improve resistance to weather perils, the majority of agriculture in developing countries remains highly susceptible to extreme, uncontrollable weather events that can severely impact both quality and yield of a crop. Such events include excessive or insufficient rainfall and extreme temperatures.

The effects of weather risk are felt most acutely at the household level, particularly by poor, vulnerable agricultural households, the majority of which are subsistence farmers.

Index based Weather (Crop) Insurance represents a newly developed alternative to the traditional crop insurance programs for smallholder farmers in the developing countries. It aims to mitigate the hardship of the insured farmers against the likelihood of financial loss on account of anticipated crop loss resulting from incidence of adverse conditions of weather parameters like rainfall, temperature, frost, humidity etc.

The key feature of IBWI products is that these do not indemnify crop yield losses at the individual field or grower level, but rather use a proxy variable (the index) such as the amount of rainfall, or temperature, or wind speed to trigger indemnity pay out to farmers.

The interest in using index-based agricultural insurance has grown in recent years, particularly with respect to addressing the systemic component of agricultural production losses. Index-based insurance offers several advantages over traditional insurance relying on individual losses, including lower monitoring costs and more transparent indemnity structure. It reduces the occurrence of moral hazard and adverse selection. It also eliminates the need for field visits, which speeds up claim settlement and significantly reduces costs. Because the insurance is based on a reliable and independently verifiable index, it can be reinsured, allowing insurance companies to transfer part of their risk efficiently to international markets.

Index Based Insurance can be implemented effectively at various levels to reach out the vulnerable population. The description / features of the Index Based Insurance at various levels are given in Annexure I.

The World Bank's Experience with Index-Based Insurance

The World Bank has assisted several of its member countries in developing or enhancing index-based insurance products. In 2003, BASIX formed a partnership with ICICI Lombard General Insurance Company (a joint venture between ICICI Bank and Lombard, Canada) to pilot the sale of rainfall index insurance contracts to small farmers in the Andhra Pradesh State of India with the technical assistance from the Commodity Risk Management Group (CRMG) of the World Bank and was the first weather insurance initiative launched in India and the first farmer-level weather-indexed insurance offered in the developing world. Ever since, there have been several other pilots around the world, including completed pilots in Ukraine, Ethiopia, and Malawi, and upcoming pilots in Kenya, Tanzania, Thailand Sri Lanka and Central America.

1.2 Successful models for Macro Level Index Based Insurance

1.2.1 Weather Based Crop Insurance Scheme of India (WBCIS)[1]

To bring more farmers under the fold of Crop Insurance, Pilot Weather Based Crop Insurance Scheme (WBCIS) was announced in the Union Budget 2007 in selected areas. WBCIS is intended to provide insurance protection to the farmers against adverse weather incidence, such as deficit and excess rainfall, high or low temperature, humidity etc., which are deemed to impact adversely the crop production. In additional to Agriculture Insurance Company of India (AIC), private insurers like ICICI Lombard, IFFCO Tokio and Cholamandalam have also been permitted to implement the Scheme in selected areas with same level of support as AIC, to provide competitive service to the farmers.

As per the scheme design, the farmer share is collected by the insurers against which the state and central government release their respective share of subsidies.

During the 2011-12 season, the WBCIS was implemented in 14 states spread over 139 Districts for the major crops during Kharif and 70 Districts during Rabi crop season. The scheme covered more than 2 Mn farmers and crops spread over 2.7 Mn hectares for a Sum Insured of $ 4 bn.

Please refer Annexure II for the details of Weather Based Crop Insurance Scheme of India.

1.2.2 The Caribbean Islands – CCRIF

The first multi-country disaster insurance was implemented in the Caribbean in 2007. The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a regional risk pooling facility, owned, operated and registered in the Caribbean for Caribbean governments. Sixteen Caribbean governments are currently members of CCRIF. The economy of the region is extremely dependent on natural resources, including fisheries, agriculture and tourism, which are very sensitive to climatic conditions. CCRIF is designed to limit the financial impact of devastating hurricanes and earthquakes by providing liquidity very quickly after a major event. CCRIF functions like business interruption insurance against Government revenue reductions in the aftermath of major natural catastrophes. Coverage is designed to cover short term revenue shortfall and NOT infrastructure, indirect social costs etc. It is capitalized by donors and participants (via a membership fee). CCRIF initially raised capital to cover claims and operating costs from donors (US$50 Mn) and from its participants (US$22 Mn). Donor capital is now over US$65 M. Its claims paying capacity is greater than the modeled aggregate annual loss with a 1 in 10,000 chance of occurring. It uses parametric index, which converts wind speed (for storm) or ground acceleration (for quake) into a government loss estimate at key sampling sites, which are aggregated to national loss. Since the inception of CCRIF in 2007, the Facility has made eight payouts totalling US$ 32,179,470 to seven member governments.

1.2.3 R4 Rural Resilience Initiative in Africa

The United Nations World Food Program (WFP) and Oxfam America funded by USAID and Swiss Re respectively have launched the R4 Rural Resilience Initiative in 2011. It is presently operating in Ethiopia and Senegal and will be initiated in two other developing economies. R4 builds on the initial success of a holistic risk management framework developed by Oxfam in Ethiopia: Horn of Africa

[1] http://finmin.nic.in/the_ministry/dept_fin_services/insurance_division/Govt%20sponsored%20Socially%20Oriented%20Insurance%20Schemes.asp?pageid=5

Risk Transfer for Adapt-action (HARITA) project to enable poor farmers to strengthen their food and income security through a combination of risk reduction, prudent risk taking, and risk transfer and risk reserves. Given its scope and success so far, Rockefeller Foundation has also joined the initiative lately.

HARITA is an integrated approach to risk management against drought among farmers growing Teff. HARITA was innovative in its approach as it brought together a network of partners including Ethiopian farmers, to build an insurance for-work" program on top of the government's 'food- and cash-for-work'-Productive Safety Net Program (PSNP), that serves eight million chronically food-insecure households in Ethiopia. The Ethiopian National Meteorological Agency also played a strong role in supporting weather data collection and analysis for the weather index insurance. The resulting innovation allowed cash-poor farmers the option to work for their insurance premiums by engaging in community-identified projects to reduce risk and build climate resilience, such as improved irrigation or soil management. In its three years of delivery in Ethiopia, HARITA has scaled from 200 households in one village in 2009 to over 13,000 households in 43 villages in 2011.

1.2.4 Agroasemex in Mexico

Mexico is highly vulnerable to catastrophic weather events that cause excess rainfall and drought. These are further aggravated by the El Niño phenomenon and cyclones. The majority of arable land is sown with basic grains such as maize, beans, sorghum and barley. The first small-scale pilot was carried out in 2002 in various regions of Guanajuato State and insured 75,000 ha of maize and sorghum against drought. It was based on a rainfall index and used five weather stations. The program since then has grown to cover over 800,000 farmers and USD 1.5 Bn worth of agricultural risk. The government-owned AGROASEMEX designed and implemented this index insurance product in order to transfer Mexico's catastrophic agricultural risks to the financial market. In this model, farmers don't pay for insurance. It collects the premium from the federal government and the counties. AGROASEMEX developed a methodology using reanalysis techniques to obtain simulated series of weather variables to overcome lack of historical data. It has proven to be an effective model to provide a relatively fair claim settlement and also to transfer domestic risks to international markets.

1.2.5 Forage Rainfall Plan in Ontario, Canada

Ontario, one of the provinces of Canada, located in east-central Canada experienced low rainfall consecutively from year 1998 to 2000. Hence, in 2000 the Ontario provincial government initiated a ***Forage Pilot Programme*** to protect producers from the financial consequences of forage production decreases due to **drought**. In 2003 the Forage Pilot was renamed the ***Forage Rainfall Plan*** and became a formal part of the Government's ***Production Insurance (PI)*** programme, a nationwide federal/ provincial/ producer cost-shared crop insurance programme. It protects farmers against yield reductions and crop losses due to adverse weather and other insured perils. In addition to PI, in 2003 the Agricultural Policy Framework (APF) established the ***Canadian Agricultural Income Stabilization (CAIS) programme*** to protect farm operators from declines in income by combining stabilization assistance with disaster assistance. In 2008, APF was replaced by the new five-year Growing Forward policy framework, which established **AgriInvest** and **AgriStability**. These programmes replaced CAIS, and PI continued under the new framework.

Programme participation has increased every year. The number of acres insured has increased from a mere 37,576 acres in 2000 to 448,794 acres in 2008.

1.3 Successful Meso and Micro level Index Based Insurance Models[2]

1.3.1 Municipalized Risk Group in Rio Grande do Sul, Brazil

The State of Rio Grande do Sul located in southern Brazil, suffers from weather risks such as drought, flooding and hail, and these are exacerbated by the El Niño phenomenon and its sister effect, La Niña. El Niño's higher volume and intensity of precipitation cause flooding whereas La Niña is characterized by deficit rainfall, extensive dry spells and drought. Both events can cause extensive erosion and loss of soil moisture and adversely affect farming and hence affects livelihoods of almost one fifth of Brazil's population lives in rural areas.

The program was Launched by the state government – and under the coordination of AgroBrasil Seguros a partnership was formed with the state's Department of Agriculture and Supply [Secretaria de Agricultura e Abastecimento] (SAA), the State Bank of Rio Grande do Sul (Banrisul), and the State Data-Processing Company [Companhia de Processamento de Dados do Estado] (PROCERGS).

To improve sales, AgroBrasil and the SAA developed the AgroNet® software program. Installed at all seed distribution points, the application cross-checked information on farmers' seed requests against insurance data on the municipality, such as the sum insured and the area-yield index of that municipality.

In seven years (2001-2008), 194,100 families growing maize were insured (27.8 per cent of the PTTS families). More than R$18.2 million (US$9.1 million) in indemnities was paid to 57,778 families, or 1.1 per cent of the state's total value of maize production.

1.3.2 PepsiCo contract farming program in India

To protect the farmers in its supply chain from weather events, PepsiCo offers index insurance as part of its contract farming programme. The insurance is sold through the ICICI Lombard General Insurance Company, a private sector insurer, and managed by Weather Risk Management Services (WRMS), a private broker and weather station operator. PepsiCo added index insurance to its contract farming package not only to limit farmers' weather risk, but also to establish long-term relationships with farmers and limit the risk in its supply chain.

Index insurance was first offered through the contract farming programme in Karnataka and Maharashtra in the Sharif season (June through October) in 2007, West Bengal and Punjab in the Rabi season (December through March) in 2007, and then in Uttar Pradesh in Rabi in 2008.Index insurance was first offered in 2007

This index insurance programme was designed to cover potato crop losses due to late blight disease, which in turn is associated with weather events that can be indexed. Among PepsiCo contract farmers, roughly 95 per cent elect to purchase index insurance. Approximately 50 per cent of those insured by the index insurance programme were smallholders, owning less than 5 acres (2.025 ha) of land.

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[2] http://www.ifad.org/ruralfinance/pub/weather.pdf

1.3.3 Malawi - Weather Index Crop Insurance[3]

The World Bank, in close collaboration with Malawi's National Association of Small Farmers (NASFAM), developed an index-based crop insurance contract that is more efficient and cost-effective than traditional crop insurance and can easily be distributed to individual smallholder farmers to increase their access to finance and to protect farmers and loan providers from weather risk. The program was piloted in 2005 to help farmers manage weather (drought) risk, facilitate farmers' access to agricultural credit by reducing the risk of smallholder loan default; and allow banks to expand their lending portfolio to the agriculture sector without increasing default risk.

In 2005, 892 groundnut farmers purchased weather-based crop insurance policies for a total premium of US$36,600. As the crop insurance contracts mitigated the weather risk associated with lending, local banks came forward to offer loans to insured farmers. In 2007, the pilot was expanded to cash crops. By 2008, the number of participants had increased significantly, with 2,600 farmers buying policies worth US$2.5 million.

1.3.4 BASIX Index Insurance Program

Weather insurance in India was first launched in 2003 as a private initiative by BASIX (A Hyderabad-based micro-finance institution) and ICICI Lombard (insurance company), with technical assistance from CRMG. The first pilot program for index-based weather insurance was launched in the Mahbubnagar district of Andhra Pradesh in the Kharif season 2003. During the pilot year, the weather insurance policies protecting against low rainfall was sold to 154 groundnut farmers and 76 castor farmers. It was linked to crop loans that BASIX had provided to these farmers.

In 2004, BASIX incorporated farmer feedback into the design of the second generation of improved weather insurance products that were sold to over 700 farmers, several of whom were repeat customers from the 2003 pilot. In subsequent years the programme was expanded to cover eight states for both Kharif and Rabi seasons, for a cumulative 39,864 farmers. Premium rates are **3-8** per cent of the sum insured.

1.3.5 Kilimo Salama – Index-based Agriculture Insurance - Kenya4

(Kilimo Salama means "safe farming" in Swahili)

Kilimo Salama, an index-based insurance product that covers farmers' inputs in the event of drought or excessive rainfall, was developed by the Syngenta Foundation for Sustainable Agriculture (SFSA) and launched in partnership with Safaricom (the largest mobile network operator in Kenya) and UAP (a large insurance company based in Kenya). Launched in 2008, it is now the largest agricultural insurance program in Africa. Kilimo Salama is the first such program worldwide to reach smallholders using mobile phone technology.

As the basis for its rainfall index, the Foundation adopted the widely used Water Requirement Satisfaction Index (WRSI)

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[3] http://www.gfdrr.org/gfdrr/sites/gfdrr.org/files/documents/DRFI_Malawi_WeatherInsurance_Jan11.pdf

[4] *Kilimo Salama –Index-based Agriculture Insurance, A Product Design Case Study by IFC*

Kilimo Salama's use of technology is the key to the Microinsurance product's affordability and the model's scalability. Kilimo Salama's clients are smallholders scattered throughout rural Africa. To reach them, the program partners with agricultural microcredit institutions and local agro-vets or stockists who sell farming inputs like seeds, fertilizer, and crop protection products. **Mobile phone application is used** to sends the farmer an automated SMS with his or her policy number and insurance payout owed to client farmers at the end of each growing season. **Solar-powered weather stations** provide accurate rainfall measurements and also communicate other useful data for farmers.

The Kilimo Salama initiative was undertaken by IFC -GIIF and partner institutions.

Key Macro level comparison of various IBWI programs across the globe is elucidated in Annexure III.

1.4 Lessons learned from the successful meso and micro level index based insurance models

Please refer to Annexure IV for the summary of lessons learned from the successful meso and micro level index based insurance models.

1.4.1 Key Lessons for Zambia

We have identified some key important aspects to be taken care while implementing a Weather index Insurance program in Zambia. Taking stock of the learnings from various programs across the globe, the key issues needs to be focussed for successful implementation of the WII program in Zambia are been sorted out in Annexure V.

2 Agriculture Insurance in Zambia

2.1 Present Status

Zambia has a small yet robust system of agricultural insurance. The insurance companies are regulated by the Pensions and Insurance Agency (PIA). A range of products is available e.g. covers against fire, lightning, drought, damage by animals, hail etc. and several different types of crops, including both food and cash crops can be insured. Insurance is also available for cattle and other livestock.

However, this is a relatively recent development. Until the last decade, agricultural insurance was rare in Zambia, and was only offered in a limited way by Company F. Now private insures also provide agricultural insurance products. Still the insurance coverage is skewed towards large commercial farm owners who insure their crops at the insistence of their bankers. Overall, the present commercial agriculture insurance penetration is still low, constituting just about 2.5% (approx $ 4 mn[5]) of the total premium collected by General Insurance Companies. It may be noted that the agricultural sector contributes about 19% of the national GDP[6].

Types of agricultural insurance products offered in Zambia by the insurance companies and their key features are been detailed out in Annexure VI.

The insurance companies mainly reach farmers through bank-assurance tie-ups and arrangements with large farmer associations. As the banks mainly cover the medium to large growers and have no or very limited outreach among small growers, the number of covered small growers by agricultural insurance is also very low. A few of the large insurance brokers also bring proposals from their farming clients to the insurance companies. The companies do not engage individual or corporate agents to reach out to farmers. The insurance companies offer commissions to the banks, farmer unions and the brokers based on the amount and quality of business. The commission ranges are wide and vary between 5-50%.

The products are mainly on the lines of Multi-Peril Crop Insurance (MPCI) with customizations according to crop requirements. A sample policy wording from one of the insurance companies is being submitted along the report[7]. As the MPCI involves settlements based on verification of losses by loss inspector, details of farm and land ownership as well as past farming records is required for underwriting purpose. The MPCI underwriters insist on adequate protection against fire and theft, these measures are very elaborate and according to us can be afforded only by large growers. As several small growers practice shifting agriculture they are unable to provide consistent land ownership records and historical yield data and are hence usually not covered under MPCI. All Micro-Finance institutions who have recently started engaging with small growers have reported to us that their clients were denied agricultural insurance coverage.

The agriculture insurance claims are evaluated once the insured farmer files a claim. The insurance companies use miscellaneous methods to verify a claim. Their methods include conducting crop cutting experiments in the area, using proxy loss measures such as rainfall in the vicinity e.g. nearest weather station where data is available and also comparing yields with neighbouring farms. The

[5] Estimated from figures given by insurance companies
[6] IFAD, Govt. Of Zambia, wikipedia
[7] The company has requested us not to share the wording publicly

insurance companies consider present claim settlement mechanism as costly and inefficient and cite this as also a reason for not giving covers to small growers as their acreages won't justify the costs incurred for loss adjustments

It seems to us that, the insurers offer agriculture insurance products on paper but resist real implementation fearing high administrative costs in settling claims. Further as the farmers are scattered across vast geographies, insurers find it difficult and costly to distribute insurance products. In most of the cases, farms are covered for theft and fire. Yields are covered for commercial farmers with proven records of accomplishment

While Company F has reinsurance lines, several smaller private insurers lack reinsurance arrangements and therefore co-insure risks.

2.2 Insurance Regulations[8]

The Pensions and Insurance Authority (PIA) is the regulatory and supervisory authority for the pensions and insurance industry in Zambia. The PIA was established under the Pension Scheme Regulation Act no. 28 of 1996 and the Insurance Act No. 27 of 1997. Prior to the enactment of the Act No. 27 of 2005, PIA existed as Office of the Registrar of Pensions and Insurance under the Ministry of Finance and National Planning. The stated objective of the PIA is "To regulate the conduct of pensions and insurance industry through prudential supervision in order to protect the interest of pension scheme members and insurance policyholders and to foster the industry's growth, development and stability". It derives its powers from the Pension Scheme Regulation Act No. 28 of 1996. It is the regulatory and supervisory authority for the Pensions and Insurance industries. The principal Acts that it administers are the Pension Scheme Regulation Act No. 28 of 1996 and the Insurance Act No. 27 of 1997. In this regard, it issues guidelines, policies and regulations and is the entity responsible for drafting suggested amendments to the Insurance Act itself. It also licenses and supervises insurers. All registered insurers have to report information (including audited financial statements) to the PIA. The PIA also has the mandate to take a policy stance on new or relevant issues, for example the role of Micro-Insurance, and to initiate regulatory changes to accommodate it. The PIA is managed by a Registrar and two Deputy-Registrars for insurance and pensions respectively and governed by a Board.

Insurance in Zambia is regulated by the **Insurance Act, 1997**, as amended by Act 26 of 2005 (henceforth referred to simply as the Insurance Act). It is supplemented by the Insurance Regulations issued by the PIA. The current act is under revision and a draft regulation has been circulated by the PIA for feedback.

A comprehensive insurance regulation review was recently carried out by the ILO. Main conclusions of this study are extracted from the report and presented below

Generally facilitative regulatory regime: Zambia has a financial inclusion policy in place and the PIA supports microinsurance development. This sends an important signal to the market. Furthermore, the Insurance Act does not (through minimum upfront capital requirements) set a high barrier to entry for prospective players. There are no commission caps and the file and use product approval system facilitates innovation. AML/CFT and credit regulation pose no real challenges to insurance provision or expansion. Though there are institutional limitations on the type of organisation that

[8] PIA website

may register as an insurer, there are no “candidate organisations” such as cooperatives that are affected by this at present. Furthermore, the PIA is willing to cross the demarcation divide (a significant constraint to microinsurance development in some other jurisdictions) for microinsurance products.

Some uncertainties and challenges*:* There are nevertheless a few elements of the regulatory framework that may hamper microinsurance development. With the 2005 amendments to the Insurance Act also came a number of ambiguities, such as the lack of clarity on the definition of short-term life insurance. While the PIA addresses these inconsistencies through its supervisory approach and has shown itself willing to accommodate development and innovation, it risks an ad hoc approach to regulation that does not facilitate regulatory certainty. It furthermore risks creating an unlevel playing field as there is no consistent framework within which the supervisor’s positions can be based. Compliance costs may also be increased if each company needs to approach the PIA individually in the absence of clear industry-wide guidelines and it risks placing the application of the law at the mercy of individuals. It is therefore important that the uncertainties in the Act itself be resolved.

As also noted by the ILO report, the regulators and the provisions of the insurance act are generally positive to allow index insurance in Zambia. However, policy framework for index insurance related dispute resolution is required. The PIA notes that the judicial dispute resolution is slow and very time taking. Considering that index insurance presents a different nature of disputes related to basis risk etc than the conventional indemnity based MPCI, a separate framework for dispute resolution needs to be prepared and the judicial system need to be educated on it. Such a framework will also require an independent agency to provide technical inputs on claim contentions. An agricultural university or the local meteorological department could play this role.

The insurers will have to submit the index insurance products for approval under the file and use mechanism. The PIA deputy registrar welcomes index insurance products and does not foresee any problems in approval of the product.

The PIA is of the view that a few General Insurance Companies do not have sound solvency ratios, and therefore sound reinsurance arrangements are necessary before launching agriculture insurance. The regulator considers agriculture insurance necessary for the growth of the poor households and regularly persuades the insurance companies to expand the coverage to poor growers. The deputy registrar of PIA also thinks that a cover on behalf of the small growers may also be sponsored by the government.

3 GEO-CLIMATIC FEATURES

3.1 Zambia at a glance

Zambia is a developing African country with a large part of the inhabitants living in rural areas. It is situated on the great plateau of Central Africa. The country has a tropical climate with three distinct seasons, the cool and dry season, the hot and dry season and the hot and wet season. The country is landlocked surrounded by 8 neighbouring countries of Democratic Republic of Congo and Tanzania to the north, Malawi and Mozambique to the east, Zimbabwe, Namibia and Botswana to the south and Angola on the west. The key socioeconomic indicators and geographical features of Zambia are been given in tabular form in Annexure VII.

FIGURE 1ZAMBIA'S POSITION IN SOUTHERN AFRICA

Source:http://www.zambia-mining.com/africa.html

3.2 Geographical and demographical status of Zambia

Zambia is divided into ten provinces namely: Central, Copperbelt, Eastern, Luapula, Lusaka, Northern, Muchinga[9], North-Western, Southern and Western.

The details on province wise cities and districts of Zambia are shown seperatly in the Annexure VII (Fig 2 and Table 9).

Almost 60% of Zambian population lives in rural areas. Rural Zambia is characterized by large agrarian economy with high poverty rates that has remained stagnant over the years. Distribution of population among the provinces is depicted in figure 3 enclosed in Annexure VII.

3.3 Climate and Agro-Ecological Zones

Zambia’s climate is pleasant tropical, but seldom unpleasantly hot, except in the valleys. There are wide seasonal variations in temperature and rainfall. October is the hottest month. **The main rainy season starts in mid-November, with heavy tropical storms lasting well into April.** The northern and north-western provinces have an annual rainfall of about 125 cm (50 in), while areas in the far south have as little as 75 cm (30 in). May to mid-August is the cool season, after which temperatures rise rapidly. September is very dry.

Agro-Ecological Zones of Zambia: In Zambia, farming systems have to a great extent been influenced by the physical and climatic characteristics of the three major agro-ecological zones. A map to illustrate the three main zones are described in the Annexure VIII, Fig 4.

The details of major agro-ecological zones is given below:

[9] Muchinga province was separated from Northern Province recently in 2011 and is consisting of Chinsali, Isoka, Mafinga, Mpika, and Nakonde districts from Northern province and Chama district from Eastern province

Region I covers the valley areas located in the extreme southern and western parts of the country. It is characterised by low rainfall, short growing season, high temperatures during the growing season, and a high risk of drought. This is generally a dry area with less than 800mm annual rainfall and best suitable for production of small grains and livestock rearing. Although maize is unsuitable it is still grown at subsistence level. Crop production in this region is mostly at subsistence level and therefore households depend on food from outside this region to meet their needs for part of the year.

Region 2, which covers the central part of Zambia, has annual rainfall in the range of 800mm to 1000mm and is subdivided into two regions. The plateau areas of Lusaka, Central, Eastern and Southern Provinces that are by far the most productive areas in the country in both food and cash crops make up the first region and called zone 2a. The second region called zone 2b which is less productive covers the Kalahari sand plateau and Zambezi flood plains. It has potential for Cassava and rice production as well as cattle rearing.

Region 3, which is a high rainfall area with amounts exceeding 1000 mm per year, covers Northern, Luapula, North western, Copperbelt and northern parts of Central province. This is a high Cassava growing and consuming region. Due to the nature of the rainfall pattern, soils here are to a large extent highly acidic limiting the production potential.

Please refer Annexure VIII (Table 10 & 11) for the key characteristics of Zambia's major Agro Ecological Regions

The 28 Livelihood Vulnerability zones as described in the World Bank baseline survey are depicted in the the Annexure VIII (Fig 5)

3.4 River Basins and Population

There are two main river basins in Zambia namely the Zambezi and the Congo River Basins. Zambezi covers almost two thirds of the country along the south-central area - and the Congo covers the northern part. The basin of the Zambezi River has 13 sub-basins, each representing major tributaries and segments. The River and its tributaries are subject to a cycle of floods and droughts that have devastating effects on the people and economies of the region, especially the poorest members of the population.`

Barotse and Kafue sub basins are major sub basins of the Zambezi River with a total catchment area of 115,753km^2 and 155,805km^2 respectively, constituting 20% of Zambia's total land area and are are most exposed to climate extremes.

Please find the specific Location of Kafue and Barotse River Sub-Basins in Zambia detailed in Annexure IX.

KAFUE BASIN plays a central role in Zambia's economy with concentration of most of the mining, industrial and agricultural activities. Almost 50% of Zambia's population is concentrated in this basin. Almost 50% of the total Zambian crop production takes place in this area. The basin evenly spreads across Zone IIA from the centre to the south and Zone III towards the north. More specifically the basin is spread over the Copperbelt mining zone and the Chama Lundazi Rice zone in the north, Mufumbwe –Kasampa Zone and central maize-cotton belt in the middle and the Line of Rail commercial zone in the south.

The northern part of the basin is highly urbanised, with wage employment in mining, manufacturing, banking and trading sectors being the main livelihood options for most people. Staple food production is minimal. Copper mining is the main economic activity in the zone, although due to the recent sale of mines, a number of people have been retrenched and have migrated to other zones. Apart from mining other common livelihood activities are charcoal burning and game, the zone has relatively good infrastructure.

The central part of the Kafue basin is spread over Mufumbwe –Kasampa Zone and central maize-cotton belt the zone is self-sufficient in food production and is sparsely populated. It has a good road network and rail system, except for Lufwanyama, Mufumbwe and Kesempa districts in the western part. It is also a major forest reserve and is criss-crossed by two national parks. Timber, honey and game are the major sources of livelihood. In the eastern parts of the central Kafue basin, there has been increased demand for land for agricultural purposes from retrenched, retired and unemployed people. There are moderate numbers of commercial farms in the zone, mostly growing maize, coffee and soya beans. In the Mumbwa district, Maize and cotton growing is widespread. This area is not prone to drought as rainfall is normally adequate and has moderate access to the market.

The southern part of the Kafue basin, much of which lies inside the line of rail commercial zone, has a mix of rain-fed and irrigated crops. The soils are good and so many different crops are grown. Access to agro inputs is good because of the proximity to towns. Access to markets is good. In the southwest part of this territory where road infrastructure and the general terrain is poor (Kafue River flat plains), fishing and game form the major sources of food and income. However, the North-Eastern parts of the territory is characterised by commercial production of maize, cotton, tobacco, sugarcane and grain legumes. The area has good infrastructure, thereby promoting trade. The population is large and livestock diseases are common hazards. Lately the area has been prone to drought. Deforestation is prominent due to charcoal sales and curing of tobacco.

Most of the **BAROTSE BASIN** is part of what is called the Western flood plain, which is sparsely populated with low productivity crops, and sustenance based agriculture. This basin cuts across the Zone IIA, IIB and touches the Zone I towards the south. More specifically, it covers the Zambezi flood plain and the Sioma plains. The sioma plain is a cropping (maize and cassava) and cattle-rearing zone. Incomes for most households come from limited crop and livestock sales and to some extent timber sales. Cattle also provide manure, draught power and milk. Market channels are moderate to difficult mainly because of poor infrastructure. Farmers and traders mainly sell cattle through local butcheries and main abattoirs. Maize and cassava is purchased from the local market. The Zambezi flood plain is a low-lying wetland that floods yearly. The floods are excessive with a frequency of one in ten years, destroying crops and infrastructure. Households grow maize, rice and sorghum and keep cattle and pigs. Pigs are kept mainly for sale. The area is dissected by the Zambezi River, offering opportunities for fishing and water transport. There is the potential to produce two crops of maize per year in this livelihood zone[10].

3.5 Zambia Disaster Profile

The country has experienced natural disasters such as drought and floods with increasing frequency in recent years. During the 2007/08 rainy season, traditional drought prone areas (southern/south eastern Zambia) were also flooded. Traditional flood prone areas lie on the Zambezi and Luangwa

[10] Zambia Vulnerability Assessment committee

river basins i.e. Mazabuka and Namwala in Southern Province around the Kafue flats, North-Western and western provinces and Eastern province.

During the period starting from 1980 to 2010, Zambia witnessed 38 disastrous events where in around 9 Mn people were affected and 1311 people lost their lives. Details are been provided in Annexure X.

4 Agriculture

In Zambia agriculture plays a key role of generating employment particularly in rural areas, providing foodstuffs essential for the sustenance of acceptable nutrition standards among the population as well as supporting industries by the production of the required raw materials. The agriculture sector in Zambia has been identified as a key driver for the economy due to its high potential.

4.1 Key features of Zambian agriculture[11] [12]

- The Zambian climate is favourable for agricultural production, with abundant arable land receiving 650mm of rainfall in the southern part of the country and 1800mm in the North each year.

- Only 4.5% of the total arable land is cultivated.

- It has been estimated that only 65,000 hectares or 13% of a potential 500,000 hectares irrigable land has been actually developed for irrigation in Zambia.

- The sector's contribution to real GDP averaged 19% making up 39% of earnings from non-traditional exports while agricultural growth has been around 4% over the past three years.

- Agriculture production and income is highly asymmetric with 50% of the commercial production coming from less than 5% of growers. Cultivable land is similarly asymmetrically distributed with approx 70% of the growers having land holding of less than 2 ha per household.

- Smallholder agriculture is characterized by a general inadequate productivity which is the main cause attributed to rural poverty and is partly explained by the weak technical and commercial skills of smallholders; poor knowledge of improved low-input farming techniques; labour constraints; poorly functioning input and output markets; high costs of transport; and lack of support services. An important additional cause of rural poverty is the increasingly restricted access to social services such as health and education, particularly for the poorest.

- Lack of markets for timely buying and selling, the lack of support services like credit and extension and mostly timely distribution and cost of fertilizers are hindering smallholder's productivity. On average, rural households have access to approximately three hectares of land. This amount of land could allow households, in most areas, to produce enough food staples and other foods to cover consumption needs. However, access to land, the quality of land and soil, varies by province. The lowest mean access to land is in North-western Province and the highest is in the Central province. The Eastern and Southern Province have areas (notably near line-of-rail or towns) those are densely populated and average land availability per household is often insufficient to cover food staple consumption needs.

- Generally, planting is done from November to December, however early planting (October) is practiced in parts of the country especially the north. The main harvesting takes place from April to June for all rain-fed crops except cassava, which is harvested all year round.

[11] IAPRI

[12] www.zamstats.gov.zm, IFAD

The green (early) harvest takes place between February and March, which characterizes the end of seasonal hunger period.

Please refer to Annexure XI (Fig 6) for the Agriculture Calendar of Zambia for the better understanding on the cropping cycle.

4.2 Farm holding & Income Pattern:

According to official sources, Government classifies agricultural producers as follows: about 800.000 smallholders cultivating 1.5 hectares on an average, using hand-hoe technology and retaining most production for own consumption. These smallholders contribute 65% of all maize production, 75% of groundnut, 85% of sorghum, 95% of millet, 55% of sunflower and 95% of the cotton produced in the country. Another 50,000 emergent farmers cultivating 5-20 hectares and using draught power and purchased inputs in areas along the line of rail; and finally 600-750 large-scale, mostly family- owned farms cultivating 50-150 hectares using mechanized farming techniques in areas along the line of rail. Finally a dozen large corporate operations, most of which are integrated with agro-processing.

The asymmetry across the various farmer categories is better understood by the way growers are segmented in local academic literature where the farmers are segmented by way of their approach to agriculture, ownership of farm assets and linkages with institutions. E.g., there are three major categories of farmers in Zambia as identified from the IAPRI (working paper 64) and summarized in table below:

TABLE 1 CATEGORISATION OF FARMING COMMUNITY IN ZAMBIA

Type of Farmers	Characteristics			
	Land holding	Income	Other Assets	Crops Grown
The 'No-Road ' takers to Agriculture prosperity (approx 70% of the growers)	small land holders (0-2 Ha)	$130-250	negligible farm assets, 1-2 cattle per House Hold (HH),	• Grow maize for sustenance • Occasional surplus for sale on local markets
The 'Low-Road' takers to Agriculture prosperity (approx 25% of the growers)	2-6	$ 300-500	5-6 cattle per HH	• Along with food crop they Also grow Cotton, paprika, other cash crop assisted by out-growers • Low margin but disciplined cultivation • Profits gradually ploughed into horticulture
The 'High-Road' takers to Agriculture Prosperity (approx 5% of the growers)	>6	$ 1200 and above	10-12 cattle per HH	• Grow high investment, high margin crops. • Horticulture growers • Also grow maize to capitalize on govt subsidy

The above classification is not merely statistical but also gives crucial insights into the lives and ordeals of the growers. E.g., the Low-Road takers remain stuck at the foot of the mountain, finding no traction in farming and no access to pathways leading upwards. Through good fortune or good weather, they may experience periodic upswings in farm productivity and welfare. However, if they are unable to invest surpluses in assets that will sustain them during setbacks (drought years, pest infestations, and diseases), they rapidly revert to their prior low-productivity status in subsequent years. Only a small minority of smallholder farmers succeed in transitioning to high-productivity, high-volume commercial agriculture. Only about 20% of cotton farmers and less than 5% of maize and horticulture farmers succeed as top-tier commercial growers. Two pathways predominate among successful commercial smallholders. The Low-Road, exemplified by cotton production, traces a gradual upward trajectory beginning with low value output and low cash input costs. Given widespread input lending from ginning companies, cotton provides an entry point for large numbers of poor but disciplined farmers with little nonfarm income. The best managers grow their cotton business slowly over time. Although low value crops such as cotton and maize cap farm earnings at modest levels, successful farmers use cotton revenues to finance asset accumulation, area expansion, entry into higher-input agriculture, and education for their children, thus opening new pathways to high-wage nonfarm employment for the next generation[13].

The High-Road, exemplified by horticulture production, involves a steeper, more difficult but more rapid ascent focusing on high value products with commensurately high cash input requirements. Small initial savings finance inputs for very small horticulture plots. Successful farmers accumulate savings and increase their scale over time. After 15-20 years, the best attain high income themselves, accumulate savings that enable them to withstand periodic setbacks, and ensure their children's future through heavy investment in education. Highly disciplined cash management and accumulation proves essential in order to finance inputs, hire labour, and cushion shocks from erratic rainfall, disease, and price swings. As a result, financial institutions, particularly for savings, provide critical support to successful smallholder commercialization.

The major source of income for the Low-Road takers is casual labour, which contributes 35-40% of total income. Other sources of income for the poor include petty trade, crafts and crop sales. Livestock and crop sales are a minor income source for this group, which only sold chickens and goats.

Middle households earn most of their income from livestock, crop and charcoal sales. The ration between income from crop to livestock sales varies from region to region e.g. it has been noted that income from livestock and fishing contributes to almost 50-60% of the household income in the western flood plains whereas it contributes to only 30-40% of the household income in the central provinces.

Purchases form a slightly higher proportion of food sources for poor households than for middle households at 25-35% and 20-30% respectively.

4.3 Major Crops in Kafue and Barotse Basin

Zambia's staple crops include maize, sorghum, rice, millet and cassava. The main cash crops are cotton, soya, sugarcane, peanuts, and tobacco. Maize serves as the principal food staple in central, southern and eastern Zambia and supplies about 60% of national calories, while Cassava is important in northern and western Zambia (FAO, 2002). Commercial cotton spreads out across the semi-arid central and southern parts of Zambia but mostly concentrated in eastern Zambia.

[13] The paragraph has been reproduced from the IAPRI working paper 64

Commercial horticulture production tends to concentrate in close proximity to major urban centres and along major transport routes leading to them (depicted through figure in Annexure XI, Fig 7).

Production of major crops and area under cultivation in Zambia are presented through graphs in Annexure XI (Fig 8 & 9).

Kafue forms part of the central and Northern Provinces. Part of the region comes under the AEZ IIA and part under AEZ III. Barotse on the other hand mainly forms part of AEZ IIB also called the western flood plains.

Our calculations show that the percentage of cultivated land to the total available arable land in Barotse is lower than the national average i.e. 4.5% but it is higher than the national average in the Kafue.

TABLE 2 ZONE WISE CULTIVATED AREA UNDER MAJOR CROPS

Major Crops	AEZs (Cultivated area in ha (approx.))			
	AEZ I	AEZ IIA	AEZ III	AEZ II B
Maize	100,000	700,000	304,923	90,000
seed cotton	23,253	279,710	Negligible	Negligible
Soya, groundnut	15,576	86,180	9,320	5000
Cassava	538	15,935	313,588	48000
TOTAL	**1,39,367**	**1,081,825**	**6,27,831**	**1,43,000**

Source: Ministry of Ag, Zambia

Maize is the main staple crop in Kafue region, which has substantial acreages under cash crops such as Cotton, Groundnut and Soy. In Barotse Cassava and Maize are the main staple crops with negligible acreages under cash crops

4.3.1 Maize

Maize is the principal staple food in Zambia. The Zambian "maize belt" consists of agro-ecological Zone 2 (medium rainfall and high altitude) and parts of Zone 3 (high rainfall and high altitude). Figures for region-wise maize production are given in a graph in Annexure XI (Fig 10). Maize is grown in the rainy season, from November to April. Although rain-fed cultivation prevails for maize, it is also grown in the dry season where irrigation facilities are available.

Maize receives intensive government input and marketing support. In contrast, cotton relies primarily on private contract farming schemes, while horticulture enjoys no large-scale institutional support from either the public or private sectors.

Information on the institutional support framework around the Maize crop is extracted from various "Indaba Agricultural Policy Research Institute" (IAPRI) papers and reproduced for the benefit of the reader.

Maize has been highly politicized and heavily subsidized since the 1930s. Beginning in 1936, British colonial authorities established a Maize Control Board (MCB) to facilitate control of food prices and bulk procurement for the urban mining centres of Northern Rhodesia. The MCB became the government's instrument for subsidizing commercial maize production and controlling urban markets through a system of internal and export quotas. At independence in 1964, the MCB became the National Agricultural Marketing Board (NAMBOARD), which guaranteed input supply and output markets. From 1974/75, NAMBOARD procured maize at a fixed pan-territorial price (Wood et al. 1990). The NAMBORD worked through farmer co-operatives also locally called the parastatals. Subsidy schemes promoted animal traction, tractor ploughing, and subsidized maize inputs throughout Zambia (Wood et al. 1990; Kokwe 1997). To support these efforts, the government established a Cooperative Credit Scheme (CCS) and an Agricultural Finance Company, which later became the Lima Bank, for purposes of financing the agricultural sector on subsidized terms. Most of their lending focused on maize (MACO 2004). Recurring heavy losses led to the de facto bankruptcy of Zambia's many co-operatives by the late 1980s. At NAMBOARD alone, losses accounted for 16% of government spending by the early 1990s (Howard and Mungoma 1996). Under heavy donor pressure, structural adjustment of loans during the 1990s mandated liberalization of Zambia's agricultural markets (Smale and Jayne 2010). With the abolition of NAMBOARD in 1990, maize became the province of private traders and cooperative societies. At the same time, the volumes of subsidized fertilizer distributed to government channels diminished steadily as donor support withdrew. Rising fertilizer prices, coupled with the removal of subsidized pan-territorial NAMBOARD prices, led to a sharp contraction in maize profitability at the farm level. As a result, maize production fell perceptibly as farmers, particularly in northern Zambia, reverted to production of alternate food crops such as cassava, groundnuts, and sweet potatoes, while commercial farmers in central and eastern Zambia increasingly turned to cotton (Zulu et al.) 2000). The CCS and Lima Bank folded up their operations at the same time, leaving a vacuum in agricultural financing since the mid-1990s (MACO 2004).

However, government absence from Zambia's maize markets proved short-lived. Beginning in the early 2000s, after a decade-long absence, the Zambian government resumed active trading in maize markets. In 2003, Zambia's newly created Food Reserve Agency (FRA) began making large-scale maize purchases at a pan-territorial price. Increasingly large government purchases have coincided with growing domestic stocks and direct government control over export markets (Mwanaumo et al. 2005). In recent years, the FRA has paid roughly a 30% premium over the prevailing market price (Mason and Myers 2011). Despite the high cost to Zambia's Treasury, the FRA's presence in Zambia's maize market has grown since its inception, culminating in the 2010/11 crop year with the purchase of 880,000 tons of maize, amounting to over 80% of smallholder maize sales (Mason 2011).The resumption of state activity in maize markets has not been solely confined to output markets. The Zambian government likewise resumed large-scale distribution of subsidized fertilizer to registered farmer cooperatives through the Fertilizer Support Programme and its successor, the Farmer Input Support Programme (FSP/FISP). Since the mid-2000s, FSP and FRA expenses have accounted for 50% to 70% of government spending on agriculture (Govereh, Jayne, and Chapoto 2008; Tembo et al. 2009). In total, subsidized fertilizer accounts for one third of all the fertilizer used by maize producers in Zambia. The resumption of fertilizer subsidies and large-scale government maize purchases at subsidized prices has helped to stimulate a resurgence in smallholder maize production since the mid-2000s. It is widely believed that the rise in maize productivity over the past few years is the result of increased distribution of subsidized seeds and fertilizers. Bulk of the agricultural credit for maize comes from existing co-operatives. Private Banks and MFIs prefer to stay away from maize lending fearing interventions from govt. on support prices.

Maize is a low-value, high-input crop. For that reason, poor farmers are rarely able to launch commercial farming careers as maize farmers. Instead, the poor transit first via cotton and then move to maize during years when prices make this attractive. Well-off rural households, who can afford to pay high mineral fertilizer and seed prices, are able to consider commercial maize production. They must also have the financial capacity to wait for delayed payments by the FRA

4.3.2 Cotton

Cotton is one of the important cash crops of Zambia. Cotton production is heavily concentrated in Eastern province, over one-third of smallholders from this area involve in cotton farming. Eastern Province continued leading in cotton production with two third of total production (60%, expected production 2011/12, as per CSO 2011/2012 Crop Forecasting Survey) while Central and Southern provinces trailed far behind at 20 percent and 12 percent respectively. The Province-wise expected production of Seed Cotton is given in Annexure XI (Fig 11).

Information on the institutional support framework around the cotton crop is extracted from various IAPRI papers and reproduced for the benefit of the readers.

Like maize, Zambia's cotton market remained under tight state control during the early independence years. From its formation in 1977 until its demise in 1994, the Lint Company of Zambia (LINTCO) managed all facets of cotton production and marketing in Zambia. At planting time, LINTCO provided certified seed, pesticides, sprayers, and extension support to farmers. At harvest, LINTCO purchased all cotton at a fixed price. Although LINTCO did succeed in initiating commercial cotton production in Zambia, like NAMBOARD, it incurred heavy recurrent losses, which forced the government to disband the company and sell off all of the corporation's assets. Two private ginning companies purchased the LINTCO assets. London-based Lonrho purchased the ginneries in central and southern Zambia, while South Africa's Clark Cotton purchased LINTCO's equipment and facilities in the east, leading to a duopoly in the early years of privatization. Unlike maize, cotton marketing has remained fully privatized since liberalization in 1994, despite several significant boom and bust periods. A recent review traces five distinct phases since the privatization of LINTCO in 1994. "During the post-reform boom (1995-1998), the sector remained heavily concentrated and expanded rapidly on an entirely private and unregulated basis; the first crash (1999-2000) was marked by a severe credit default crisis, brought on in part by the entry of new, small ginners and cotton buyers committed more to trading cotton than to promoting its production. The credit default crisis was resolved during the second boom, (2000-2005) entirely through private innovation by the two leading companies to reduce credit default; during this phase, government became increasingly involved in the sector, but their activities are best characterized as adjuncts to the fundamental private sector dynamic, and achieved mixed results. Additionally, larger and better-financed ginners entered; by the end of this period, the sector was becoming recognizably less concentrated than at any time since reform. Several factors brought on the second crash (2006-2007): a sharp appreciation of the kwacha, unhelpful public statements by government in the midst of mounting conflict between farmers and ginners, and the weight of additional firms in the sector, all of which lead to another serious credit default crisis and plummeting production. By the end of this period, still more companies had entered the sector, bringing the total to at least 11. Production recovered somewhat in 2008 but remained essentially flat in 2009" (Tschirley and Kabwe 2010).

Since 2009, a sixth phase has emerged as rising world cotton prices have resulted in strong incentives to grow cotton. As a result, Zambia's cotton production has resumed its upward trajectory. Between 2008 and 2012, the number of farmers growing cotton has roughly doubled, from about 100,000 to over 200,000. In 2012, Zambia's cotton sector retains its two market leaders, Dunavant and Company A as well as half dozen smaller players. The industry leaders supply input packs on credit to their farmers, as do some of the smaller competitors. The larger companies also provide regular extension services and training at critical periods during the cropping season. In return, the farmers contract to sell all of their cotton production to their parent ginnery. The ginneries deduct input costs and interest charges at harvest time, remitting the net profit in cash or bank transfer to their farmers. Because of this out-grower relationship, cotton farmers require no cash to finance input purchases. However, cotton production requires careful management, including timely planting, prompt weeding, regular insect monitoring, repeated spraying throughout the season, and multiple rounds of hand picking to ensure fiber length and quality. Cotton companies monitor performance of their contract farmers and quickly weed out non-performers. For this reason, commercial cotton production – unlike maize and horticulture – remains accessible to cash-poor but disciplined smallholder farmers so long as they have sufficient family labour to manage production.

Contract farming arrangements similar to cotton are available for other cash crops such as soy, paprika, sugarcane.

4.3.3 Horticulture

Horticulture markets remain the province of independent private traders and farmers. Currently, a large network of farmers, private input dealers, wholesale traders, and private retailers manage Zambia's horticulture trade. They concentrate primarily in central Zambia and in the Copperbelt, in close proximity to the urban markets along the railroads. Three main crops – tomato, rape, and cabbage – account for about 75% of smallholder sales of horticulture products.

Horticulture farmers generally sell their produce through urban wholesale markets. In most wholesale markets, a network of private brokers control access and facilitate farmer offloading in return for a commission. City councils and marketer cooperatives manage the urban wholesale market infrastructure, although disputes over market fees and access have erupted periodically in recent years. Open-air markets and street vendors dominate horticulture retail markets in Zambia and account for over 90% of all fresh produce marketed. Currently, supermarkets handle only about 5% of horticulture retailing. Although supermarkets retain large urban retail shares for many dry goods, horticulture products remain largely the province of the traditional marketing system (Hichaambwa and Tschirley 2006; Tschirley and Hichaambwa 2010).

Unlike cotton, individual horticulture farmers must finance their input purchases and coordinate marketing. Heavy disease pressure during the rainy season necessitates the use of fungicides and insecticides or investment in dry season irrigation equipment. For entry-level horticulture farmers, technical support remains largely the domain of informal farmer-to farmer networks. However, high-volume producers often consult with input dealers and with the handful of large private agribusiness firms that have emerged to sell hybrid seedlings to large- and medium-scale horticulture producers. Price volatility coupled with product perishability make horticulture marketing risky, while high values make it lucrative.

4.3.4 Livestock

As noted in the earlier sections, that livestock sale is a considerable source of income for middle and larger growers (the low and High-Road takers). Livestock situation has changed in recent years, due to disease, drought and forced selling by households to meet increasing cash needs. This loss has affected the household food consumption pattern as well as agriculture production practices. For instance it is reported that in the Southern Province due to the “corridor disease" the decline in the cattle population has resulted in a substantial loss of income and draught power to a large number of small-scale farmers.

ZAMBIA has huge opportunities in livestock, most particularly in beef production and export. It is reported that, the systems for keeping animals disease free especially dip tanks broke down after the colonial era. The damage has never been corrected and the country’s traditional cattle herds have become unhealthy or wiped out due to diseases such as corridor, FMD etc. It is reported that during floods the wild animals from the inundated forests and game reserves migrate to the nearby high altitude areas where they infect domestic livestock with diseases.

For individual farmers and households the reduced livestock growth lead to reduced food security directly from a loss of source of protein and indirectly from a loss of income from sales of livestock and reduced crop production due to loss of draft power. These combined losses have lead to a reduced quality of life for most household that have depended heavily on livestock production. The challenge for the veterinary services has been to curb this vice but it is increasingly difficult given a shortage of staff and logistic support.

In the FGDs about 50% of the participants claimed that they had suffered losses because of livestock diseases. The incidence of diseases seems to be more in the flood prone zones.

4.4 Impact of Weather on Agriculture & Existing Coping Mechanisms

4.4.1 Inputs from Secondary literature

Nature of Climate Change and Weather volatility, and impact on agriculture

The impact of the natural disasters on agriculture, livestock is well documented in the PPCR reports on strategic program for climate initiatives. According to the report; based on 1960-2003 records, Zambia has experienced the following trends

- Mean annual temperature has increased by 1.3 deg C since 1960, an average rate of 0.29 deg C per decade, with the rate of increase most pronounced during winter months (0.34 degree per decade).
- The number of hot days and hot nights per year has increased by 43 days, with the most pronounced increases between March-May (hot days) and December-February (hot nights).
- The average number of cold days and nights per year has decreased by 22 and 35 days, respectively. The decrease in cold days is similar across all seasons, while that of cold nights appears to be more pronounced between March-May.
- Mean rainfall has decreased by 1.9 mm/month (2.3% per decade); mainly due to decreases during peak months of the rainy season (December-February).

In sum, rainfall seasons in southern Zambia have become less predictable and shorter (most notably in the south-western area), with rainfall falling in fewer, more intense events.

From 2000 to 2007, the intensity and frequency of droughts and floods and the number of people affected has also changed, with a net trend towards more floods and droughts. Floods have been occurring once every 2.3 years and droughts once every 5 years, intensifying to once every three years in recent years (1991-2011). Droughts have also been occurring within rainy seasons, such as in 2000/01, 2001/02, and 2004/05. Moreover, the area affected by floods and droughts appears to have expanded: the 2006/07 flood, for example, affected 41 districts in nine provinces, and the 2004/05 drought left nearly two thirds of Zambia with little or no rainfall.

Future climate trends in Zambia have been documented in the NAPA, a World Bank-funded Water Sector study, and in a Climate Change Knowledge Portal8. However, these projections were at a relatively coarse spatial resolution. A recent IFC study used downscaled climate data from six Global Circulation Models (GCMs) and two Special Report on Emissions Scenarios (SRES), A2 and B1. This yielded 12 different projections of temperature and precipitation for the period up to 2100, using 1960-1999 as a base. The results are as follows:

- While average annual precipitation is not projected to change significantly – model results range from -3% to +3% by 2100 - precipitation variability is expected to increase. During the early rainy season (October-December), precipitation levels are projected to decline – equivalent to three months out of the 7-months rainy season becoming drier. By contrast, the proportion of rainfall resulting from heavy events is projected to increase, particularly during December to May. By 2100, the IFC study indicates maximum 1-day precipitation increases of over 275% for some scenarios. There is a net positive change (about +11%) in Kafue River flows. Projected increases in average annual temperature are 3-5 deg c for Zambia and 3-6 deg c for Kafue Basin by 2100. By 2060, models indicate temperature increases of 1.2-3.4 deg C, with the largest increase in the northern and eastern regions. By 2060, the number of hot days and nights are projected to increase significantly throughout the country, by 15-29% and 26-54%, respectively.

- The projected changes in precipitation variability could lead to more intense floods and longer and more severe droughts. Simulated changes to the probability of exceeding flood thresholds – defined as a 15% deviation from normal rainfall for the rainy season – indicates that floods are expected to continue to occur frequently in the future.

- The agriculture sector in Zambia is already highly vulnerable to changing climatic conditions due to a high reliance on farming for livelihoods, and the preponderance of small-scale, rain-fed cultures, grown primarily during the wet-hot season (November-April). Zambia's recurrent droughts and floods have caused widespread crop failure in the past, in high rainfall years due to water logging and erosion, and in dry years by delaying the onset and length of the growing season. During the 2004/05 drought for example, nearly two thirds of the country received little or no rainfall, affecting even large-scale cotton and tobacco production. Significant rainfall deficits and/or flash floods during critical periods of crop growth have also frequently led to serious production shortfalls, with consequent impact on food security and nutrition. The rising temperatures are expected to further increase the outbreak of plant and livestock diseases. The impact of climate change and variability on agriculture has been assessed through collaboration between the University of Zambia and the Center for Environmental Economics and Policy in Africa (CEEPA). This 2006 study suggested that an increase in mean temperatures during November-December and a reduction in mean precipitation during January-February would impact negatively net farm revenues, whereas the impact would be positive for increases in mean temperature during the growing season (January-February) and an increase in mean annual runoff. Overall increase in weather volatility will impact farming practices and risk management methodologies.

Agricultural Risks and Coping Mechanisms

As per the Zambia Vulnerability Assessment Committee (ZVAC), the most common hazards in the flood prone zones i.e. much of Barotse and the South-western part of Kafue river basin include flood, drought and cattle diseases such as CBPP. Although flooding is normal and has been adapted into household livelihood patterns, excessive flooding in February through May damages crops, destroys infrastructure and results in livestock and human diseases. Furthermore, when there is excessive flooding, some areas become inaccessible by road making it difficult to reach those in need of assistance. One has to be cautious about referring to floods as chronic hazards. Floods in this livelihood zone are both a threat and an advantage, and it is difficult to distinguish between these two. While on the one hand floods damage crops, grazing areas and houses and block communications, they also bring fish/kakeya, which are a major source of income and food in the zone.

Flood is not the only risk faced by growers in the two river basins. A poor start to the rains causes delayed planting, whilst prolonged dry spells during the peak rainfall months (December – February) results in reduced crop yields due to moisture stress. The northern and central parts of Kafue are more exposed to rainfall volatility related risks and here the risk of flood is both improbable and minor.

ZVAC notes that there are three strategies by which households tried to avert the effects of hazards: maximizing income, minimizing expenditure and shifting consumption patterns. The most common response strategies include sale of livestock, labour migration to other districts, the collection of wild foods, increased sale of timber, increased fishing and a reduction of non-essential expenditure. Unusually large volumes of livestock sales and labour migration after August suggest that households are struggling to cope with effects of averse weather in the previous agricultural season and high food prices. If labour migration is excessive, then land preparation for the next season is negatively affected. The main chronic hazard experienced in the Kafue and Barotse basin is cattle disease (particularly Contagious Bovine Pleuro Pneumonia or CBPP). This reduces livestock numbers and productivity every year. One strategy that is commonly employed in bad years is to reduce non-essential expenditure. Households reported reducing expenditure on clothes, relish and other non-staple items in bad years.

According to the ZVAC – "The final picture is that poor households cannot cope with the effect of disasters, despite employing numerous response strategies including expanded wild food collection and sales of forest products, and use of the limited opportunities for casual labour. This holds true even if staple food prices remained stable or the same compared to the reference year (rather than the doubling illustrated above). In other words, poor households are unlikely to be able to cope with the other aspects of the bad year problem. This highlights how fragile the ecosystem is if people continue to depend on the same food and income sources without improving farming methods, market structure, infrastructure and above all the huge dependency of the poor on forest products."

Commercial smallholders prepare to face inevitable but unpredictable shocks by building up financial reserves and livestock assets, both of which provide savings that enable farmers to resume commercial farming following a catastrophic season. One farmer explained that her success hinges on, "planning well and having chickens to fall back on when sales are poor due to price collapse." Where banks are available, they shelter funds far from prying relatives. The more successful horticulture farmers, who travel frequently to town for marketing, often secure their funds in commercial bank accounts. Mobile money transfer systems, common elsewhere in Africa, are only just now emerging in rural Zambia. Where formal savings institutions are unavailable, farmers keep a cash reserve in a special hiding place in their house, separate from normal transactional cash. A key difference between successful commercial smallholders and those who attempt but fail is the discipline to build up financial reserves. This ability reflects not just management skills but also the ability to prioritize business investment over consumption needs. As one farmer admonished, "Save and invest. Don't misuse your money."

4.4.2 Inputs from the FGDs and Household Interviews

The household survey and FGD (Focus groups discussions) was conducted in 4 Districts covering the Kafue and Barotse regions:

Area 1 -Chibombo, Kafue and Masaiti districts in Kafue basin [14]

Area 2 -District Mongu in the Barotse basin[15]

In every district, we conducted about 75 interviews to get a total sample of 302 Household interviews. 12 focus groups discussions were held in the 4 sample districts (4 per district).

Administratively, Zambia is divided in Districts, Blocks (which may comprise several villages) and Camps, which may include 2 or more communities. Therefore, sample was designed with the support of Ministry of Agriculture through the district level DACOs (District Agriculture Coordinators), who cooperated with Block officers and Camp officers to help in the selection of sample units. Focused group discussions were conducted at 12 locations (please see Annexure XIX and XX for details) in the Kafue and Barotse regions.

The sample included a majority of small farmers women (41%) and men (59%) with an average age of 45 years, but large concentration of respondents being between 30 and 48 years of age and living in an average household of 8 members. 53% of respondents have finished secondary education while 39% only primary. More than half own farms with 3 or less hectares of land which is for the vast majority not owned according to legal land titles but under customary law. Half of the respondents have a bank account. 30% of respondents (20% being women) have obtained a loan in the past 12 months.

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[14] Zone I which includes Kafue is found in parts of the Eastern, Western and Southern Provinces, receives 600-800 mm of rainfall annually and has a short growing season with high temperatures and a high risk of drought. The most suitable agricultural activities are extensive livestock production and low-input cultivation of drought-tolerant crops. Almost 50% of all rural people live in this zone. Kafue,Chibombo and Masaiti Kafue districts represent the south central and northern territories of Kafue basin and were selected so as to represent the wide variations in the agricultural practices and livelihoods across this basin as reported in the secondary literature

[15] Mongu is situated in the western province on a small promontory of the Zambezi River running north-south, which regularly floods in the wet season. The whole region is flat and sandy, with the dry land generally no more than 50 m higher than the floodplain. The area has an annual average rainfall of 945 mm falling in the rainy season from late October to April. The flood usually arrives by January, peaks in April and is gone by June, leaving a floodplain green with new grass on which a population of about 250,000 moves in to graze a similar number of cattle, catch fish and raise crops in small gardens. Mongu is hot from September to December, with a mean maximum for October of 35.4°C. It is one of the best rice growing area in Zambia. Also good for tiger fish production and mangos. Mongu lies at the border of the Sioma and Zambezi flood plains. Villages were chosen across the district in manner so that we get a flavor of the practices adopted in both Sioma and Zambezi flood plains.

Historical perspective of catastrophic events affecting livestock and crops

For crops main causality is severe weather related events and for livestock causality is diseases-related. These are also the circumstances for which mitigation measures and coping mechanisms were considered important to adopt. The farmers have also indicated many other disaster events which are not weather related or livestock related (such as wild animals destroying or eating crops, lack of good quality and variety of seeds provided by government in 2009). These events are indicative of other problems on crops and livestock (for example the lack of infrastructure such as gates and ridging around the property to protect from animal invasion)[16].

The table given in the Annexure XII (Table 14) illustrates the responses of farmers about the history of catastrophic weather-related events destroying crops (2/3 of cases) other negative events affecting livestock mortality (1/3 of cases).

Weather related disasters and coping mechanisms

Two thirds of farmers consider weather-related disasters responsible for total loss of crops and in particular. For example, Kafue is particularly affected by lack of rain, floods and droughts; almost half of the farmers have indicated pest attack on livestock a disastrous event.

Farmers are complaining about changes in rain patterns, especially in the South. Rain periods are more often coming without any predictability and in between dry-spells periods, or with heavy rains followed by cycles of low rains, making it hard to plant stable crops such as maize. Increasing production failures are causing food insecurity issues in all survey areas. Farmers are therefore trying their best to anticipate drought and heavy rain damages by attempting new and different farming activities and trying to change as much as possible their agricultural traditional patterns to adapt to the needs of these unpredictable weather patterns. For more than 75% of the respondents planting dates have become more variable since the year 2000. FGDs have provided several indications on how farmers are collectively dealing with weather related catastrophic events (droughts, heavy rains, floods and dry spells periods) and these arrangements are common ways among farmers of finding different farming approaches. Responses by district were consistent both in the case of individual farmers and in the case of farmers belonging to cooperatives or farmers associations.

Ex-ante risk management mechanisms

Among the most common ex-ante risk management mechanisms and mitigation measures across the different districts are:

- **Crop diversification:** Diversifying crops in order to minimize risks of a failed production season. Usually farmers may do maize and then turn into cash (cassava, cotton) and/or drought resistant crops (groundnuts, soybeans, sweet potato and sunflower).
- **Inter-cropping:** Mixing different planting seeds on the same plot (in Kafue they like to mix maize fields with beans using a certain distribution pattern);
- **New seeds:** Using early maturing seeds although yield quality is lower;

[16] FGD responses are attached in annexure XIX

- **Conservation agriculture:** Conservation farming and early maturing seeds: in September maize early maturing seeds are planted in potholes and after 2 months farmers have produce avoiding the worst of the dry season spells late December –January;
- **Gardening:** women especially are very much engaged in gardening activities that allow a sufficient production for consumption and often manage to provide additional produce for the nearby markets (i.e., watermelon and pumpkin in November and other fruits and vegetable)
- **Small Livestock as savings:** Chicken rearing to prepare for cash or food shortages
- **Off-farm activities:** Business set up with the support of soft loans.

Ex-post coping mechanisms

When farmers deal with a disaster and food is no longer available then farmers attempt to raise some cash primarily by:

- Selling their livestock (1/2 of the sample), although this is often done at distressed prices);
- Borrowing money (1/2 of the sample) – usually through informal sources, better off extended family members or moneylenders at very high interest rates [17];
- Offering daily labour in other people's farms or by offering other services (1/3 of the sample);
- Selling charcoal ,Other ways of raising some form of income and recover loss crops is by selling burnt wood, burning fields, preparing food (only when some food is still available in the household) to prepare and selling it on the markets.

Crop diversification as a coping mechanism

Generally speaking, those smallholders who had access to subsidized agricultural inputs and credit prior to liberalization now receive little government assistance and insufficient extension services to help them substantially diversify crops and/or find other ways of producing more effectively.

According to the household survey and focus groups feedback, crop diversification is considered as an important need especially to respond to new climate changes challenges. But it is often hard for it to take place correctly because of lack of assistance, high costs of inputs, inadequate agricultural tools, lack of supply aggregator systems (Please see section below on soy bean), and poor access to credit to help small farmers to invest in an improvement in agricultural production.

Some of the risk management measures (short term and long term) practiced by the farmers against weather risk in Kafue and Barotse sub basins are been produced in the Annexure XII (Table 15).

Farmers lack know-how and consider risks of embracing new crops are too high.

Risk management practices and coping mechanisms indicated during the focus group discussions are not always successful or completely widespread and often present limits and conditions. For

17 One Focus group mentioned that money lender interest rates can be up to 40-50% per month

example, some farmers consider risky to engage in crops that are not used for consumption, as they tend to not separate production for consumption from production for markets. So, although many consider important to diversify crops, they feel they are putting their crops at risk by moving into the production of crops that are not directly into their consumption scheme. Unless they farmers are told how to do it through training and assistance from extension services or inputs distributors or they are part of cooperatives, clubs and farmers union programs.

Finally they need loans to invest in new seeds and new techniques, but affordable loan programs are not so accessible. In fact, during difficult times farmers have in few cases turned to individual moneylenders, which have set prohibitive interest rate and repayment schedules.

Drought resistant crops: Sunflower and Soybean.

According to a senior Agribusiness manager in the Zambia National Farmers' Union, soybeans, sunflower and oil processing as well as livestock feeding industries are all well established and increasing and farmers should increasingly turn into these new crops. However, more work is needed from the farmers unions' side, to guide farmers into new cropping habits. For this to happen there is a need for a concentrated effort from agricultural programmes promoters, financial institutions proposing acceptable loan schemes (such as the LIMA Credit scheme supported by the Zambia National Farmers' Union), insurance companies protecting the farmers and ultimately NGOs and grassroots organizations working to sensitize and inform farmers. In addition, farmers point to the fact that for soybeans especially, large quantities of product are needed to create critical marketable amounts. Instead, they do farm on small lots thus production of soybeans for small holders is still not so accessible and perhaps not viable. Furthermore, they need to find ways to aggregate supply as there is still not a system in place to transport produce to the buyer or there are no market outlets available.

Knowledge of and attitudes towards weather insurance programmes

From both baseline survey and focus groups discussions, insurance is something farmers have heard about but it is not yet part of their risk management portfolio. In fact, the number of people having purchased any type of insurance is insignificant (only 1 farmer in the baseline survey and 5 in the focus groups). Respondents understand the concept of insurance especially when explained through life insurance or vehicle insurance. During the focus groups, farmers were also asked to suggest an adequate distance for a weather station. People gave responses by providing indication of the maximum distance between two farmed areas sharing similar weather patterns.

The concept of WII was explained during the data collection for the survey and the focus groups. It was clarified that it is an insurance and as such it requires a premium to be paid by the beneficiary and that the insurance indemnity payments will then be based on values obtained from a weather index that serves as a proxy for losses rather than upon the assessed losses of each individual policyholder. Also it was explained how the WII is based upon an objective measure (for example, rainfall) that shows strong correlation with crop yield and that the weather variable that can form an index must satisfy the following properties: observable and easily measured, objective and transparent, independently verifiable, reported in a timely manner.

Once the concept of Weather index insurance had been explained, farmers seemed to rank the importance of such an instrument as high and very high (on a scale 1-10, majority opted for the 3 highest scores) and during the focus group the possibility that such a risk management instrument could be purchased was received with very high interest. However, we could not get clear responses on the amount the farmers are willing to pay as insurance premium. Generally, the farmers wished the premium to be included as part of the loan from the micro finance institutions. In few cases, farmers were willing to pay an amount equivalent to one chicken approx $ 1-2 as premium for insurance products to cover their crops.

5 Weather monitoring infrastructure

5.1 Available weather monitoring infrastructure

Zambia became member of the World Meteorological Organization (WMO), a specialized agency of the United Nations. In JANUARY 1967 ZMD established as a specialized agency under Ministry of Communications and Transport (MCT) ZMD has now broadened its operations to cover other applications: agriculture, water resources, health, disaster management, tourism, industry, etc. The ZMD provides a comprehensive range of weather and environmental services for the aviation community, from recreational pilots through to airports and global airlines. ZMD has 41 multi parameter meteorological stations. The stations locations are depicted in a figure in Annexure XIII.

The ZMD has 41 installed weather stations, 39 of which are manual stations and two are automatic weather stations. The automatic weather stations are currently not operational due to some minor repairs needed. None of these 41 stations has autographic equipment to give continuous data.

In 2012, the department received additional 5 automatic weather stations from COMESA, funded by the European Union, but these stations are not yet installed due to shortage of funds to facilitate the exercise. The UNDP has recently installed eight meteorological stations as part of its climate change management initiatives

There are also 300 volunteer stations (rain gauges), registered with ZMD but owned independently. Many of these stations are currently not in operation because they lack measuring glasses.

Accessing historic data in Zambia is difficult, as the ZMD would normally not give out more than 5 years data for any one station unless there is a special arrangement with the ZMD. Having this agreement at the start of any pilot work will be crucial. The law governing the distribution of meteorological data has not been passed, but the 6th National Development plan has a program catering for meteorological requirements under the public Private partnership. This will allow the selling of data to the public, but in the mean time, no raw data is sold out. A letter to the Ministry of Water and Natural Resources has to be written through the Met department for clearance to get the raw data.

We could get decadal rainfall data for about 31 locations from the ministry of agriculture. The data had minimal gaps and the cumulative seasonal data matched with climatology ranges for the respective agro-ecological Zones.

There is no crop cutting experiment based formal crop yield estimation system in Zambia. The Ministry of Agriculture estimates yields through its annual household survey.

5.2 Weather monitoring through satellite observations

Weather parameters can be estimated using satellite observations. E.g. the NASA TRMM (Tropical Rainfall Measurement Mission) is broad sampling footprint between 35°N and 35°S and providing some of the first detailed and comprehensive dataset on the four dimensional distribution of rainfall and latent heating over vastly under sampled oceanic and tropical continental regimes. TRMM fills many gaps in our understanding of rainfall properties and their variation. These includes:

a) Frequency distributions of rainfall intensity and areal coverage;

b) The partitioning of rainfall into convective and stratiform categories;

c) The vertical distribution of hydrometeors (including the structure and intensity of the stratiform region bright band); and

d) Variation of the timing of heaviest rainfall - particularly nocturnal intensification of large meso-scale convective systems over the oceans, and diurnal intensification of orographically and sea-breezed forced systems over land.

TRMM also enables mapping of larger time and space variations of rainfall in quasi-periodic circulation anomalies, such as the Madden-Julian oscillation in the western Pacific and ENSO over the broader Pacific basin. Furthermore, the critical onset of large annual circulation regimes, such as the Asian summer monsoon, can be more thoroughly studied. The TRMM data sets at a resolution of 1 degree by 1 degree are available since 1997 for the tropical regions.

The NMC (National Meteorological Center, US) reanalysis data is also useful to estimate weather parameters. The reanalysis data sets for the whole globe at a resolution of 1 degree by 1 degree are available since 1979. The SSI analysis and the Global Spectral Model are two of the three principle components (the third being the observation quality control programs) of the NMC data assimilation system. The system cycles on itself. The Global model moves the system along in time; the SSI corrects the time integration toward the observed values, providing the initials conditions for the next 6-hour integration.

The European satellite mission has products, which can measure evapo-transpiration (ET) process on land. The phase change of water molecules produces neither emission nor absorption of an electromagnetic signal. For this reason, a direct observation of ET by remote sensing is hardly possible and consequently ET has to be accessed through indirect means. Nevertheless, Satellite Remote Sensing (SRS) has the potential to provide meaningful variables driving the ET process. The methodology followed here is to force a Soil-Vegetation-Atmosphere-Transfer (SVAT) scheme with relevant data (short and long-wave fluxes (DSSF, DSLF), albedo (AL) and in next versions LAI, FVC, SC) derived from MSG and auxiliary data (air temperature and humidity, wind speed, atmospheric pressure...) from other sources.

Given that used equations in satellite imaging are only approximations of reality, a first source of uncertainties is introduced by the physical formalism of the parameter estimation algorithm itself. A second source of uncertainties results from the errors associated with each input of the algorithm, e.g. in the case of evapo-transpiration data sets the inputs come from other DSSF, AL components. The main uncertainties cumulated on the ET product deal with: sensors performance, accuracy of cloudy pixels identification, accuracy of atmospheric corrections, surface heterogeneity and land cover classification. Due to these uncertainties, it is important to first calibrate the available satellite estimates with actual ground observations.

Further most of the satellite estimates are applicable for a geographical area of 1 deg by 1 degree i.e. 100 Kms by 100 Kms. Rainfall variability is too high (please refer section 5.2) and estimates at these resolutions are not useful to capture the variations in weather at the farm level.

5.3 Requirement of Weather Monitoring Stations

- As rainfall is the most important weather parameter and arguably the most difficult to measure, we may estimate the no. of weather stations required to settle claims based on criteria to measure rain**.** As per WMO guidelines a rainfall gauge is required every 500-900 sq km (one every 25to 30 km) in flat regions and every 100-250 sq km (one every 10 to 15 km) in hill/mountainous regions of temperate, Mediterranean and tropical zones . In the Focused Group Discussions we conducted, the farmers suggest that they would like to have stations not far than 20 km from their fields i.e. 1 station every 400 sq km.

- Considering these benchmarks, as well as the total land area of the two basins i.e. 1, 50,000 sq km, the two basins will require approx 160 to 300 automatic weather stations each as against the present network of 42 non-automated stations available in the whole of Zambia.

- The assessment of stations can also made using a different approach. As per WMO, The optimum number of rain gauge stations that should exist in order that the mean rainfall can be estimated with an assigned percentage of error is given by

$$N = \left[\frac{C_v}{\varepsilon}\right]^2$$

$N = \textit{optimal number of raingauge stations}$

$\varepsilon = \textit{allowable degree of error in the estimation of mean rainfall}$

$C_v = \textit{coefficient of variation of rainfall based on the existing m stations (in \%)}$

Now most of the index insurance contracts will be settled based on seasonal or monthly rainfall data for which the CV is high i.e., approx 50-60% for the whole rainy season an approx 80-100% for the months. Assuming the acceptable degree of error is 5%, the number of stations required to estimate mean rainfall should be approx 100 to 400 for each of the regions, depending on the nature of the index insurance contracts required i.e. monthly or seasonal. If the degree of error required is lower say 2-3% or if we have to settle contracts on fortnightly rainfall for which CV is even higher, the number of rain gauges required comes to approx 400-500[18].

- The order of number of stations required by the two different approaches is roughly similar and displays the lack of adequate weather monitoring infrastructure in Zambia, though the precise number of stations will depend on the degree of accuracy required. Parameters like temperature, solar radiation are characteristically less volatile than rain and so the number of stations estimated for rain should be sufficient to capture these but humidity depends on specific landscape features like water bodies, forests etc, and so density of humidity stations required in certain regions could be higher than what has been estimated for capturing rain.

- It may be noted that the proportion of arable to total land area is low i.e. 4.5% in Zambia. Therefore, one can argue that the number of stations required for agricultural purposes could be lower. However, the cultivated land is scattered across the country and is not available contiguously in select regions, so it may not be possible to reduce the

[18] A paper by Hutchinson et al published in 1974 estimates that Zambia as a country requires approx 1000 rain gauges

requirements of stations significantly. Besides, the northern part of Zambia is hilly and the density of stations required will be higher.

Apart from the equipments, a weather station network will require following support infrastructure

- Trained staff for repair and maintenance: One person can handle approx 20 stations installed within 60km radius of his/her base. The person should have all the essential sensors and equipments to replace and rectify any damaged station data at short notice. Further, he/she needs to visit the station once every three months for regular maintenance. As the stations will be installed in remote villages, the maintenance staff should have personal conveyance (motorbikes) so that they can reach the station sites in time in case of emergencies (e.g. station damage etc)
- Warehouse Architecture: Small stores (200 sq foot area) should be available with each maintenance staff where he/she can keep necessary station components for repair and replacements. A larger warehouse (500 sq foot) will be needed at a central location from where all stations sites can be reached easily. High value components and AWS spare will be kept in the central warehouse.
- A computer server with proper power and storage back up to receive data from the main stations. Two persons trained in system administration and database management will be required to maintain the server and weather database.

We estimate that the maintenance cost per station per annum will be approx $ 500 per station. The capital expenditure per station is approx $ 2000[19].

6 Scope for Index Insurance

6.1 Whom to cover and Why

As highlighted in earlier sections, agriculture production and income is highly asymmetric with 50% of the commercial production coming from less than 5% of growers. There is asymmetrical distribution of cultivable land with approx 70% of the growers having land holding of less than 2 ha per household.

One can understand the asymmetry better by analyzing the local academic literature where the farmers are classified based on their approach to agriculture, ownership of farm assets and linkages with institutions. The questions like who all index Insurance should target and why is best answered by looking into the requirements of these different segments of farmers.

[19] Though a comprehensive weather stations with high degree of accuracy and resolution (e.g. rain resolution at 0.2 mm accuracy) with elaborate installation and security can cost as high as $ 10,000. For index insurance purpose a relatively lower accuracy and resolution instruments (e.g. rain resolution at 0.5 mm) may suffice which can come at a much lower price

TABLE 3 SEGMENTATION OF GROWERS

Grower Segments	Features	Relevance of Index Insurance
The 'No-Road ' takers to Agriculture prosperity (approx 70% of the growers)	Low productivity, small land holders (0 – 2ha cultivated land) , trapped in deep poverty, grow maize for sustenance, negligible farm assets, 1-2 cattle per HH	Farmers are highly dependent on rain-fed farming. Their livestock also get affected in case of floods and prolonged drought, Insurance against abnormal rainfall helps them in securing food. However they cannot afford the insurance premium and also do not have any bank accounts. Institutional outreach (other than the FRA, FISP) to this segment is poor.
The 'Low-Road' takers to Agriculture prosperity (approx 25% of the growers)	Cotton, paprika growers assisted by out-growers, low margin but disciplined cultivation. Profits gradually ploughed into horticulture, 5-6 cattle per HH, 2- 7 ha of cultivated land)	Index insurance should be an integral part of the out grower schemes as it helps both the farmers and the procuring company[20]. Cotton farming is heavily dependent on weather. Out-growers need insurance for better credit terms and also to retain farmers in case of catastrophes
The 'High-Road' takers to Agriculture Prosperity (approx 5% of the growers)	High investment, high margin horticulture growers. Also grow maize to capitalize on govt subsidy, 10-12 cattle per HH , > 7 ha of cultivated land	High value horticulture growers are exposed to weather related risks. They maintain high level of cash as buffer to protect themselves against weather related shocks. Index insurance is highly relevant for them

- The No-Road takers undertake agriculture primarily for sustenance. A significant proportion of these are net buyers of maize[21]. They do not have access to institutional agriculture credit. A few of these (approx 30%) do take subsidized inputs from govt. outlets, apart from which their linkage with other formal institutions is minimal. While they are interested to purchase index insurance for their crops, they may not be in a position to afford premiums for crop specific index insurance as they do sustenance cultivation and their profit margins on crop production is low. Their expectation from the insurance is to get a safety net in case adverse weather events occur which can provide liquidity to buy food stuff and prevent sale of livestock. The government, through institutions like the farm Input Supply (FISP) or the FRA can part or full sponsor the safety net vouchers to achieve welfare and climate risk management objectives

[20] Please refer to the PepsiCo contract farming program in India in section 1.3.2
[21] IAPRI, CSO

thereby making index insurance affordable for the No-Road takers. As index insurance is not crop specific and does not require land ownership and past yield details, insurers can find it easy to cover small growers through it.

- The Low-Road takers partly grow cash crops such as cotton, vegetables and paparika in association with out-growers. The out-growers provide credit for agriculture inputs with assured buy back of the farm produce. Recently a few MFIs have started lending to medium scale farmers for fruit and vegetable production with assured buy back of produce by hotels and retail stores. The credit linked out-grower model is cited as one of the more efficient ways of pulling small growers out of poverty. However, other than cotton, credit for other cash crops is still very limited and available at highly restrictive terms e.g. interest rates can be as high as 40-50% per annum with cash collaterals between 10-40% of the loan amount. One of the reasons often cited to explain the limited availability of credit at restrictive terms is lack of agriculture insurance for small and medium scale growers. Therefore, Index Insurance can help small and medium scale growers by enabling access to agricultural credit at favourable terms. The Insurance product can be integrated with the agricultural credit terms and the growers can be targeted commercially this way without relying on govt support.

- The High-Road takers are commercial growers who have easy access to credit and who already take agriculture insurance MPCI schemes as part of the credit terms and conditions. Index Insurance may offer additional advantages vis-à-vis MPCI e.g. Claims can be settled faster and more transparently. The High-Road takers can be easily accessed through the existing commercial bank and insurance company marketing network.

- Of the three, which segment should be targeted depends on one's objectives. From pure commercial point of view, all the three segments should be targeted simultaneously to make index insurance viable for insurance companies as then the weather-monitoring infrastructure established in an area can be better utilized. However, the demand drivers for sales in each of the three segments are different and business plans for the respective segments to be prepared accordingly.

- The demand driver for insurance uptake in the first segment (No-Road takers) is the govt's ability and willingness to pay on behalf of these small growers. The govt may also have its own set of social objectives to meet. E.g., it may wish to provide these covers to all small growers across the country. This will imply installing and managing weather monitoring network across the country. Further arrangements need to be made so that the farmers across the country can get insurance vouchers and claim in case the insured event occurs. At present even the government agencies such as the FRA or FISP do not reach all the growers. Such bottlenecks can delay governments support. We met the Principal Economist of the dept of Agriculture and sought his views on possible support from the govt to cover no-road takers. The Principal Economist was of the view that the govt. will be most keen to sponsor the products for poor farmers, but at the same time, it would expect the insurers to show the willingness to extend coverage to the poor and expand infrastructure to settle claims for the poor farmers. The local COMESA representative who has been evaluating feasibility of index insurance in Zambia for the past few years and has interacted with govt. officials in this regard, also confirmed to us the willingness in higher circles of the govt. establishment to sponsor index insurance products. He told us that the Zambian govt. keenly follows the initiatives taken on index insurance by the neighbouring state of Malawi and wishes to replicate the index insurance model in Zambia. As noted earlier, the deputy registrar of the PIA also told us that the Zambian Govt. should be willing to sponsor index insurance for the poor farmers. It should be noted that the Government of Zambia has been providing safety nets to farmers by way of subsidies on fertilizers and maize procurement. It is reasonable to expect that the govt. will favourably consider any proposal for subsidy on WII premiums for no-road takers. The next step in this regard, as suggested by the Principal Economist will be to meet and present a case to the Minister of the Dept. Of Agriculture.

- Demand generation through the credit and out-grower model for the Low-Road takers depends on the following factors

    - Integrating index insurance schemes with Input credit schemes of cash crop out-growers such as Company C and Company A

    - Integrating index insurance schemes with IFAD (existing $ 4 mn) and DFID credit lines (another $ 4 mn) for microfinance. These credit lines are available to local agricultural finance institutions through the Development Bank of Zambia. The benefits of index insurance will be visible only when the DBZ (or IFAD, DFID) allows lowering of collateral requirements or interest rates when index insurance is bundled with credit. The more the MFIs and farmers see the immediate benefit of taking insurance, the more they will be inclined to purchase insurance. This will require convincing the DBZ on the merits of norms in case index insurance is bundled with agricultural credit.

- As the High-Road takers are to a large extent insured by local insurers under the MPCI scheme, targeting them for index insurance is best achieved by convincing the existing insurers e.g. Company F and the banks like Company G to incorporate features of index insurance in their existing product.

- Within Kafue and Barotse River basins, there are territories, which have more potential for non-govt sponsored (market driven) index insurance. E.g. while commercial farming is extensively undertaken along the rail route in Kafue region (Including Lusaka province) the southern part of the Kafue basin, much of which lies inside the line of rail commercial zone, has higher production of commercial crops. The soils are good and so many different crops are grown. Access to agro inputs is good because of the proximity to towns. Access to markets is also good. The area has good infrastructure, thereby promoting trade. The population density is high (> 100 per sq km). Microfinance institutions such as Company B and cotton out-growers are concentrating in this territory. Accordingly, this region has a high potential for index insurance. Barotse in contrast is sparsely cultivated and is part of what is called the western flood plain, which is sparsely populated with low productivity crops, and sustenance based agriculture. The western part of the basin is submerged under flood waters during the rainy season and no worthwhile agriculture takes place. The Sioma plains which are on the eastern part of the Barotse river basin are however relatively better off and have fairly large stretch of lands under maize cultivation. However, as commercial agriculture production is low and the market linkages infrastructure is poor, the region may not be particularly attractive for market driven index insurance.

- While our mandate was to explore feasibility of index insurance in Kafue and Barotse river basin, during our course of study, we found that other regions such as Eastern and Southern province have large production percentage share of high yield Maize, cotton and horticulture crops and could be considered for launching index insurance (Please refer Annexure XI, Table12 & 13) . These provinces have good infrastructure and are well connected to urban centers.

6.2 What kinds of covers are required?

1. Non-crop specific products may be designed.e.g. drought , flood index products which may be used by any kind of grower. These will specifically serve the safety net requirements of the No-Road takers. The flood products have to be carefully designed keeping in mind that flood occurences and extent depend on rainfall in the catchmet area, river water flow and the land scape. Each of thesse factors need to be incorporated in product design and threfore requires a high degree of customization. The river flow data is available with the Zambezi river authority.
2. For serving the credit-out-grower linked farmers, crop specific inex insurance products will have to be designed. These designs need to take into consideration crop diversification and othe coping mechanisms adopted by the growers. The covers need to be highly customized taking into the accout local gegraphical terrain, local risk mitigation strategies etc. As highlighted in the earlier sections the risk for majoriy of the growers relates to variation in rain, water logging etc.
3. Crops that need to covered are Maize, Cassava Cotton, Groundnut, Soya and other horticulture crops in the two sub-basins. Standard agro-meteorological charts prepared by the department of Agriculture (DAA) are available which can be used to understand the adverse weather event thresholds according to crop varieties. The level of coverage is a function of the maximum loss a farmer is likely to suffer and the premiums he/she can afford to pay. These variables are likely to vary from location to location and household to household. In absence of more information, it is reasonable to assume that the growers would like to cover the cost of production or their likely farm income. Based on these assumptions we have prepared a few term sheets for principle crops for the two regions (please refer Annexure XVII). The premiums are expressed as percentage of the sum insured and in case the growers want a lower or higher sum insured the premiums may be recalculated accordingly. The loss histories for the designed product match with the reported losses for various crops in the past.
4. For serving the requirement of the High-Road takers blended products (hybrid between MPCI and Index Insurance) will be required which can offer merits of both the MPCI i.e. high actual loss to claim congruency and index insurance i.e. faster and bias-free claim settlement.
5. Index Insurance cannot specifically cover livestock diseases as these diseases may also occur on account of non weather based reasons. However it has been pointed out that some of these diseases are influenced by weather related events and take epidemic proportions in case of floods/ extended droughts. Flood/drought based index products can be taken as reinsurance by govt’s livestock department who provides relief to livestock growers in case of epidemics when large scale floods or droughts occur. Also the safety net products may comensate the losses to livestocks due to floods, extensive drought or weatehr induced diseases.
6. As land is cultivated across the Kafue and Barotse river basins, the covers need to be provided across these regions leaving the urban centres. However, the low productive zones

and sparsely cultivated areas can be covered under the security net framework through govt-sponsored schemes. In such schemes, claims can be settled using images from satellites. Settlement using satellite images warrants that simple drought (seasonal)/flood based products be designed[22]

6.3 The segment wise sales and distribution approach

We advocate a segment-wise distribution strategy. The no-road takers can be best targeted through govt affiliated seed and fertilizer distribution agencies. The low road takers can be targeted through microfinance institutions and out-growers. The high road takers can be approached through the existing insurance companies by incorporating the index insurance features into the current MPCI products offered to the high road taker.

TABLE 4 THE SEGMENT WISE APPROACH FOR INDEX INSURANCE IN ZAMBIA

Segment	Sales & Distribution Strategy	Is it an attractive proposition for insurers
No-Road Takers (0- 2 ha)	Govt. sponsored index insurance through FRA, FISP. (At least 30% of the small growers do business transactions with FRA and FISP)	Premium potential in the order of US$ 5-mn. Insurance may be given along with the fertilizer-seed kits (for maximum 2 kits, so that large growers do not benefit unduly from the subsidy)
Low-Road Takers (2-10 ha)	Integrate with out-grower cotton schemes. Insurance companies can also appoint traders, dealers as their agents to reach to these customers Integrate with Maize-Soya rotation programs proposed by PPCR groups	Premium potential in the order of US $ 2 mn. Bulk of the premium is concentrated in Kafue region and Eastern provinces – so weather monitoring stations are required in a limited region Mobile phones available with outgrowing companies, so can be used to register or service the customers (claim information) Company C and Company A reach almost all cotton growers
High-Road takers (> 10 ha)	Insurance companies can identify the large growers and appoint traders, dealers as their agents to reach to these customers. Can club index insurance with Bank loans as well, as most farmers in this segment have access to bank loans	Premium in the order of US $ 5-10 mn. Bulk of the premium from Kafue

As index insurance enhances the existing products and services of the identified distribution partners, hence no extra incentive has to be paid to them.

The MicroEnsure's marketing and distribution model in Africa gives a good learning in this aspect. The case study on MicroEnsure's marketing and distribution model is enclosed as Annexure XIV.

22 The argument related to infeasibility of deploying weather stations in low productive zones is presented in section 6.4

6.3.1 Index Insurance value chain

The index insurance value chain is depicted in Annexure XV (Fig 13). Support from various institutions will be needed to build a vibrant index insurance ecosystem. The required support from each of the institutions are been summarized in the Annexure XV (Table 16).

6.4 Supply side Bottlenecks

6.4.1 Weather Monitoring Infrastructure

- The number of additional weather stations required to settle index insurance contracts and the associated costs have been estimated in the earlier sections. To make such a large weather station network viable one should be generating approx. $12000 (assuming commissions on insurance premium @ 10%) as premium per station to achieve a break even within three to four years. To generate $ 12000 premium income one should insure at least $ 240,000 (assuming premiums @5% of crop value) worth crop i.e. approx. 240 ha of land (assuming $ 1000 worth of crop per ha) per station. Assuming each station covers 20 km by 20 km area (i.e. 40,000 ha), one will have to cover 0.6% of the land under index insurance to achieve breakeven. Given that that total cultivable to total land ratio is about 4.5% in Zambia and even lower in certain areas (e.g. Barotse and the Western Flood Plains of Zambia), a significant percentage of the grower population needs to be covered (roughly 15%) under index insurance. Knowing that only approx. 20-25% of the farming population i.e. the low and High-Road takers are bankable and can afford to pay the index insurance premiums; to achieve breakeven, one has to ensure that almost all growers in the low and High-Road category purchase index insurance. This is a tall task considering that the concept is new and there will be initial challenges in product design and claim settlements, that will need time to resolve. Therefore, it will be difficult to recover weather stations costs through index insurance alone in the short term.

- Not all of these new stations can be used immediately for settlement of index insurance contracts. First data from these new stations (locations) needs to be compared with the data from nearby historical stations (locations) to see if these stations follow a similar pattern as the historical stations. This analysis will help reinsurers to reconstruct historical data for the new stations so that index insurance contracts for the new locations can be priced and reinsured. This data reconstruction exercise may take 2-3 years or even more and so new stations can be used for settlement of contracts only gradually. This exercise will be especially difficult to accomplish in Zambia where the new stations may not follow patterns of the historical stations. It may be noted that there are only 42 historical reference stations (against the required number of 800 to 1850, also out of the 42, only 29 stations have reasonable quality data) which may be inadequate to represent the weather variations across Zambia.

- In Zambia, agricultural production is geographically concentrated in specific regions e.g. Approx. 60% of all agricultural production and approx. 80% of cash crop production takes place in the central and Eastern provinces. The chances to recover weather stations costs is higher in these territories compared to the sparsely populated and lower productive zones e.g. western flood plains in Zambia.

- For the sparsely cultivated non-commercial zones, index insurance based on automatic weather stations may not be viable unless supported through grants or govt. support. In such regions, settlements through satellite imagery can be a better option. Satellite Imagery techniques using TRMM, EU METSTAT data can be used to assess drought or flood like situations and can also be used for settling claims. The images or the data can be downloaded free of cost from NASA and EUMETSTAT websites – but they need to be processed and re-validated. Satellite image based short period estimates can be erratic however, accumulated averages over large time periods say a month or season are more reliable. This will have implications on product design and only very generic products like seasonal drought, widespread floods can be offered.

- There can also be interest in new types of indices that can be assessed remotely with satellites, such as cloud cover or soil moisture content or even "evapotranspiration" readings for a chosen region during critical agricultural periods. This kind of data is becoming increasingly available and it may have the potential to replace weather stations for macro level applications of WIBI, such as disaster relief insurance. Despite this potential, the writing of such contracts for individuals is constrained by a credibility problem: people may not trust payout decisions made by insurers on the basis of such remote sensed and therefore 'unseen' data that may, because of basis risk, fail to correlate highly with their own on-the-ground observations.

- Models on flood occurrence based on rainfall in the river basins and river water flow will need to be developed and tested for a few seasons. Establishing flood occurrence based on satellite images in absence of updated digital elevation maps will be difficult. At places flood occurrence may have to be established using water depth sensors

6.4.2 Reinsurance

- The insurers do not have the technical capacity and reinsurance arrangements to underwrite index insurance contracts.

- There are two kinds of problems insurance companies may face regarding reinsurance capacity for index insurance

    - The reinsurance support for small deals is minimal. Usually deals worth $10,000 and above generate interest in the reinsurance market. In the absence of sufficient interest reinsurance quotes are likely to be higher than the norms in a competitive market. In the initials years the local insurance companies many find it difficult to get deals in the required order which may escalate the quotes and hence the insurance prices making the farmer pay unnecessarily.

    - Many of the settlement stations will be new with insufficient historical records. Contracts on such stations may not find sufficient takers in the reinsurance market. The reinsurance quotes by one or two reinsurers may be on the higher side, which may overprice the contract. It can be seen from the analysis in the excel sheet submitted that like Kafue have uniform rainfall pattern and it is the borders where the AEZs that the rainfall variability is high. Thus, the new stations in the uniform zones can be priced based on the other older stations nearby. While more data may be gathered for new stations in high variability zones, the new stations in the uniform zones may be reinsured through this fund

6.5 Investment Scope for IFC – SPCR

IFC can play a role in addressing the suply side bottlenecks mentioned in the previous section. In this process it can also achieve other PPCR objectives

6.5.1 Weather Monitoring Infrastructure

1. It can contribute to the development of weather monitoring infrastructure. This could include providing soft credit for purchasing and installing weather stations. The private third party administrator who takes this credit can use data from the installed weather stations for settlement of index insurance contracts and supply the data to mobile-based extension service program.

2. Our calculation shows that achieving a break even within 4-5 years on the required investment of approx $ 1.5 mn for installing about 600 weather stations to cover the entire Kafue and Barotse region may not be realistic. We estimate that a third party service provider may have to cover 10-15% of the growers in both the regions to achieve a break even within 3-4 years, which is not easy to achieve considering that even in mature markets such as India, the coverage through voluntary subscription is about 10-15%. Even alternate revenue streams from mobile phone based extension service program may not be much helpful. In order to incentivize third party administrators at-least 30-40% of the capital expenditure needs to be covered through grants or government subsidy.

3. As the required weather monitoring infrastructure is crucial for strengthening the early warning systems and climate adaptation programs. It is a necessary social good for which part investment (30-40% of the required capital expenditure) may come from the local government, the World Bank or other multi-lateral agencies such as the Swiss Development Co-operation (SDC) and the COMESA. It may be noted that both the SDC and COMESA are considering proposals to undertake programs in the index insurance space. The grant can be given to the local meteorological department (ZMD) who in turn can solicit proposals from third party service providers in Public-Private-Partnership format. However, while doing this, data quality and transparency norms should be adhered by govt. agencies. Later as the index insurance scales up the number of stations required tends to grow and it becomes difficult for govt. agencies to manage the network alone involvement of private sector agencies is required. Therefore, policy should be laid out in advance, which enables private sector companies to install and maintain stations under a broader set of rules and guidelines framed by the local govt. department.

4. The data from these stations will be provided by the Third Party Administrator (TPA) to insurers and other institutions for a fee. The data may be owned by the TPA however as noted earlier the TPA will have to adhere to the policies and norms specified by ZMD and may need to gets it processes audited by ZMD or other capable agencies. IFC may ask the TPA to submit a copy of the annual data for its records.

5. In absence of a grant or government support for the stations, the third party service providers may cover select pockets in the two basins and prune their operations to remain profitable. Guidelines for doing so are presented in section 6.6.3.

6.5.2 Reinsurance Fund

1. IFC can create a fund that can be drawn upon by a consortium of Insurance companies for reinsuring index insurance contracts. The technical support to this fund can be provided through the IFC –GIIF facility. Insurers subscribing to this facility need to compulsorily provide covers if approached by growers. The fund can in turn reinsure itself with larger reinsurance companies. The profits from the funds will go back to IFC. These funds can be parked with a Global Reinsurer as a "Captive Company" and administered by IFC- GIIF or any other capable fund manager. A part of this fund can also be reserved for meeting future climate change related contingencies.

2. The Reinsurance fund can work through a captive formed in collaboration with a rated reinsurance company. The captive can be a joint venture in which IFC can take equity or provide financial assistance. The advantage of a captive is that through it competent professionals can work with focus on building index insurance market in Zambia utilizing the rating and expertise of Reinsurance Company. The captive can in turn reinsure its portfolio with other reinsurers. There is no extra tax burden if we take the captive route**.** Through this IFC can serve the requirement of index insurance growth in other markets as well.

   The proposed captive arrangement of reinsurance fund and its functioning is been illustrated in Annexure XVI.

3. To cover premiums lesser than $ 100,000; assuming that each contract is priced at 8-10%[23] of the covered amount, a fund to the tune of $ 1.2 -2.5 mn will be sufficient[24]. There is substantial diversification in weather parameters, especially rain across locations in the two basins. If the insurers diversify well, then the fund required to cover the portfolio of contracts is much lower than the sum of the funds required to cover the individual locations and should be sufficient to withstand one or two catastrophic events within 5 years. The calculations are presented in separate excel sheets which are being submitted as part of the assignment. IFC can charge a capital cost on these funds, which can be built into the pricing of the contracts. The pricing framework is presented in the excel sheets submitted along with the report.

4. Bulk of the contracts will be on newly installed stations, for which there is insufficient data history. However, several of these stations are part of regions which have a homogenous weather profile. Please refer to the analysis on the weather profile of the Kafue and Barotse region in Section 4.4. Index Insurance contracts on these new stations can be provided based on data of historical stations in the homogenous region or AEZ which they are part of. These contracts can be reinsured by the same fund as described in the earlier paragraph.

6.5.3 What to do to recover investments fast?

- From pure commercial point of view, all the three segments should be targeted simultaneously to make index insurance viable for insurance companies, as this way the weather monitoring infrastructure and the sales force set up in an area can be better utilized. However, very often a pure commercial initiative tends to neglect the poorer segments. Therefore a viable business model target towards poorer segments should be designed keeping in mind the following principles

23 The figure is based on the contracts we designed for various crops in the region

24 Based on analyzing claims on historical data for sample drought and excess rain products

- Focus on small and medium farmer oriented credit and out-grower model. As the premiums are absorbed within the input credit, insurance is easily accepted by the growers. Further the integrated insurance – credit model meets the requirement of farmer more comprehensively than a standalone approach. However, the benefits of index insurance will be more visible when the bank allows lowering of collateral requirements or interest rates when index insurance is bundled with credit. This will require convincing the banks on the merits of lowering of risk and therefore lesser requirement of capital in case index insurance is bundled with agricultural credit. Weather stations may be viably installed in areas where there is maximum overlap and synergies between activities of various MFIs and out-growers. Crop and location specific index insurance products will have to be designed to meet the requirements of the farmers.

- Given the low outreach of MFIS and out growers among the poorer growers (the No-Road takers), presently index insurance can have substantial impact on the welfare of the poor under the security net framework. However, the demand driver for insurance as a safety net is the government's ability and willingness to pay on behalf of the small growers. The govt. inclination to pay on behalf of farmer will be high if the compensation is fair and equitably distributed. Further, the govt. should find this mechanism cost effective compared to the traditional post disaster reliefs. Implementing the security net framework across the two countries will imply installing and managing weather monitoring network across the country. Moreover, arrangements need to be made so that the farmers across the country can get insurance vouchers and claim in case the insured event occurs. At present, even the government agencies such as the FRA or FISP do not reach all the growers. Insurers will have to increase their claim dispensation outreach in collaboration with local shops, govt. agencies such as the FRA and FISP etc. Non-crop specific products may be designed e.g. drought, flood index products which may be used by any kind of grower. As weather stations in certain geographies may not be viable, satellite imagery based techniques may be more cost effective which will be in tune with the requirements of non-crop specific safety net products.

- It should be noted that AWS maintenance costs can be managed better if the network of stations is contiguous as then a single person could manage more number of stations within a single trip. In addition, this way, stations can be installed at a lower cost. Contiguous network of stations also helps in filling data gaps accurately. It also helps in estimating and forecasting weather parameters in the region, which helps to resolve basis risk related disputes. Therefore, wherever possible contiguous network of stations should be deployed. If station costs cannot be recovered due to low intensity of cultivation then satellite imagery techniques may be used for claim settlement.

- Index insurance can meet environmental protection cause best by taking into account the environmental practices in the product design and premium calculations. E.g., water-harvesting structures reduce requirements of rain and this should be reflected in the index insurance product design and premiums. This will mean more precise and customer oriented product design. Index insurance by itself cannot incentivize or dis-incentivize mono-cropping or other non-environment friendly practices. Bundling mobile-based agricultural advisory services along with index insurance programs can be useful for the farmers.

- Focus on the demand drivers for each segment as explained in section 6.

6.5.4 Risks

There are a series of risks and issues related to the implementation of weather index insurance and to the creation of a sustainable market for weather risk transfer. The main issue that pertains specifically to “index” based insurance is basis risk. Other risks pertaining to project success are limited local Insurer’s capacity, institutional risks, regulatory, legal, political, technological, technical and market challenges.

Basis Risk[25]

There are a number of ways to reduce and mitigate this risk. One is to limit the insurance to the kinds of low frequency, highly covariate weather risks that affect most people in a region. Individual losses are then much more likely to be highly correlated with the insured weather station event. This approach works best for disaster-relief index insurance. It can also work for development index insurance, with the understanding that alternative arrangements would be needed to help households manage more frequent, less covariate risks. Another approach is to identify weather indices that minimise basis risk for as many households as possible in a region. Participatory approaches to the design of insurance contracts have demonstrated the potential to reduce basis risk, but the cost of developing these indices can be high. They are also unlikely to transfer from one small region to another, which makes scaling up more difficult and costly.

Basis risk can also be reduced by increasing the number and distribution of weather stations in order to better capture spatial variation in climatic conditions when writing contracts. However, adding weather stations can be cumbersome to set up, and new stations have no site-specific historical record. Lack of historical data can sometimes be overcome by using existing records in the proximity of the new station, in combination with remote sensing data, to create ‘synthetic’ and triangulated data sets for the new station. There is also interest in new types of indices that can be assessed remotely with satellites, such as cloud cover or soil moisture content or even “evapotranspiration” readings for a chosen region during critical agricultural periods. This kind of data is becoming increasingly available and it may have the potential to replace weather stations for macro level applications of WIBI, such as disaster relief insurance. Despite this potential, the writing of such contracts for individuals is constrained by a credibility problem: people may not trust payout decisions made by insurers on the basis of such remote sensed and therefore ‘unseen’ data that may, because of basis risk, fail to correlate highly with their own on-the-ground observations. In some cases, basis risk can be reduced by carefully choosing the WII parameters (e.g., the underlying index, the time period, and the indemnity function) so that indemnities are more highly correlated with actual losses incurred. However, for heterogeneous regions, such as those with many microclimates, basis risk may be too high for WII to be effective. It is important to remember that the very characteristic that causes basis risk in WII is also what eliminates asymmetric information problems—namely, that payments are based on realisations of the exogenous index rather than actual losses experienced by the household. The basis risk is most effectively mitigated by clearly choosing a generic weather index tailored to the full livelihood risk and by communicating well the nature and purpose of the weather index insurance contract – as opposed to a crop insurance contract. Thus, even a WII contract tailored to maize; should never be called “maize insurance”.

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[25] MicroEnsure publications

Limited Local Insurer's Capacity to Handle Weather Index Insurance Contracts

Insurance companies are usually not prepared to design index insurance products for agriculture. The adoption of creative solutions such as the ones mentioned above (e.g. remote sensed data based indices) could be quite useful, but these are even more challenging for most insurance companies. As a result, companies in the developing world usually need significant support and training to design index insurance contracts, which obviously limits their diffusion and expansion. This is where the project can mitigate this risk very effectively through capacity building efforts. E.g. in Malawi, the World Bank formed a consortium of interested insurance companies, which was trained by experts on underwriting and WII product design. Each risk was co-insured by the insurance companies in the consortium, so that each could build internal capabilities.

Institutional Risks

The meteorological service capacity can be a key problem, in particular in Zambia where the ZMD has been neglected by Government and central funding. In addition, governance issues and low administrative capacity can compound the ZMD service problem and paralyse a project. ZMD quite often does not have the highest standing in the priority list of public spending decision makers, and therefore receives little resources. Further ZMD perceives its role as scientific weather forecaster rather than service provider for the public and private sectors. We also found ZMD to be reluctant in sharing or selling historical meteorological data. ZMD was more keen to provide index insurance contracts and provide an integrated package to the clients than sell data but at the same time did not have the requisite mandate to do so.

Alternate arrangements have to be made for the meteorological data service. The historical meteorological data is also available with the agriculture department which shared the decadal data with us. As we understand the day wise meteorological data can also be obtained from the department of agriculture if IFC formally requests the department for the same. Further historical satellite data is available with various international agencies (e.g. NCEP) which along with the decadal data can be used to reconstructed daily weather estimates.

For future data requirements, as noted in earlier sections, we strongly advocate providing financial assistance to the professional TPAs. While the ZMD should be involved with these TPAs as advisor or auditor, the expansion process should not completely depend on ZMD as then internal departmental bureaucracy of ZMD may stifle the pace of meteorological infrastructure expansion by the TPAs.

The data from the stations installed with support from IFC will be collected and provided by the TPA to various institutions for a fee. The TPA may ask ZMD to audit its process for a fee.

Market Risks

Our calculation shows that achieving a break even within 4-5 years on the required investment of approx $ 1.5 mn for installing about 500 weather stations to cover the entire Kafue and Barotse region may not be realistic. We estimate that a third party private service provider may have to cover 7-10% of the growers in both the regions to achieve a break even within 3-4 years, which is not realistic considering that even in mature markets such as India, after over 10 years since the first index insurance product was launched, the coverage through voluntary subscription is still about 10-12%. Even alternate revenue streams from mobile phone based extension service program may not be much helpful. In order to incentivize third party administrators at-least 30-40% of the capital expenditure needs to be covered through grants or government subsidy. The grant or subsidy towards this cause will be socially useful as it will result in development of crop early warning systems and assist climatology and groundwater studies etc. Alternately, insurers or third party agencies can still start viable index insurance projects on their own by judiciously choosing geographical areas and farmer segments, using appropriate data monitoring techniques and bundling services like agriculture and climate advisory with index insurance products. However, such initiatives may have a longer break-even period.

6.5.5 Next Steps

- Before embarking on an actual pilot, IFC should officially confirm support from the Govt. of Zambia on the possible support the latter can extend the WII pilot programs. While the govt. officials are inclined to support WII it may take a few years to translate the positive intentions into a firm policy framework. IFC should also approach the ZMD and freeze the collaboration framework between ZMD and the third party administrator. While the Insurance regulator has no in-principle objection to the launch of WII in Zambia, it will be prudent to take their official approval through one of the interested insurers.

- IFC should advise the interested insurance companies such as Company F, Company E, and Company D to launch index insurance products in Zambia. IFC can invite WII market makers who have been working in Africa, to work with the Insurance companies and facilitate the growth of index insurance market. [Names of market makers used as examples have been removed.] These market makers can act as third party administrators, product designers and undertake weather insurance sales. These market makers can be compensated by the insurance companies for their services.

- IFC can provide financial support in the order of $ 1 mn to the interested agencies in the form of loan or equity to work in coordination with ZMD to expand the weather-monitoring infrastructure and develop and sell index based insurance products. An investment plan is enclosed as Annexure XXI. The investment plan assumes a slow growth in index insurance business in line with the experience world over and expects to cover around 50,000 farming households (6-7% of total no. of farming households in the two river basins) annually from the 7th year . As the growth of index insurance will be slow, a break-even is assumed in 6-7 years. Other multilateral institutions like the Swiss Development Co-operation (SDC), UNDP, COMESA and ILO have been engaging in Zambia for launch and scale up of Index Insurance. A co-ordinated approach among the agencies will help resolve the structural bottlenecks in the growth of index insurance market in Zambia and can reduce the break even period.

- IFC should work towards arranging a reinsurance arrangement so that customized products at competitive rates can be provided. For this purpose it can enter into an arrangement with reinsurer(s). If required a separate re-insurance captive can be formed as described in earlier sections. The insurance companies can approach the reinsurance facility to cover their risk exposures.

- All working relationships with key partners should be formalised by means of legally binding contracts and memorandums of understanding (MOUs). Each MOU should clearly define the type of relationship as well as outputs, deliverables and performance standards that will have to be adhered to.

7 Annexures

Annexure I: Index Based Insurance at various level

Micro level Index Based Insurance	Micro-index based crop insurance targets farmers directly. Over a dozen countries in Africa and Central America have success-fully implemented it. A pioneering example is that of BASIX in India in 2003 when it developed an Index Based Insurance Scheme for farmers, and expanded it to cover from the initial 230 farmers to more than 40,000 farmers in three years time.
Meso level Index Based Insurance	Here, payouts are made by an insurer either to national banks or to NGOs so that they can respond to economic losses that might have resulted from a natural disaster. An example of such a scheme is being implemented in Peru, in which the El Niño–Southern Oscillation (ENSO) related climate indices are used as a proxy for extreme rainfall.
Macro level Index Based Insurance	At a macro level, a government institution or an international charity uses index insurance for a disaster relief fund or to fund relief activities following a natural disaster as in, Mexico (Fondo de Desastres Naturales - FONDEN) and the Caribbean Community (Caribbean Catastrophe Risk Insurance Facility).

Annexure II: Weather Based Crop Insurance Scheme of India (WBCIS)

Designed, Developed and initial rollout by*:* Agriculture Insurance Corporation of India, ICICI Lombard GIC Ltd, IFFCO Tokio GIC Ltd.

Pilot: Piloted in 2007 Kharif Season with 35,000 farmers in state of Karnataka and in the subsequent Rabi in 4 states covering approx. 200,000 farmers

Pricing: Technical Assistance provided to AIC towards pricing the premium by World Bank. The average premium was 8 per cent of the sum insured, depending on the type of crop and region insured – of which an average of 2.8 per cent was paid by farmers after subsidy adjustments. The premium was subsidized equally by federal and state governments.

Types of coverage: WBCIS has two different types of coverage, one for *Kharif* (June-October) against both deficit and excess rainfall and one for *Rabi* (December-March) against frost, high temperatures, humidity, excess rainfall and other risks. *Kharif* coverage is based on rainfall outputs, while in *Rabi* it uses composite index insurance as a substitute for area-yield insurance crops.

Crops covered: During *Kharif*, WBCIS covers rice, sorghum, pearl millet, groundnut, soy, sunflower, cotton; during *Rabi*, it covers wheat, mustard, chickpea, potato, cumin, coriander

Data Capturing Method: An innovative 'tripod' was employed for capturing data

- Cleaning of historical weather data, and extending them to 100 years through simulation;
- A crop-growth simulation model to capture the yield/weather relationship and establish triggers and payout rates; and
- A dense network of automatic stations to measure current weather

Performance: The coverage of farmers under WBCIS has gone up from 35,000 in Kharif 2007 to 9.3 Mn in Kharif 2011 in 16 states. Over the 2007-2011 agricultural years, the un-weighted average loss ratio was 65% and the unweighted producer loss ratio, the ratio of claim payments to farmer premiums, was approximately 130%; that is to say that for every $1 of farmer premium paid in each of the four years, $1.3 of claims were paid in each of the four years. This is lower than the producer loss ratio of 300% for borrowing farmers purchasing erstwhile National Agriculture Insurance Scheme cover between 2000 and 2008. More coverage details in the Table below (Table 5).

Government Subsidy: During the last 5 years, following has been the approximate subsidy figures

2007-2008: 14 Mn USD	2008-2009: 20 Mn USD	2009-2010: 25 Mn USD
2010-2011: 92 Mn USD	2011-2012: 90 Mn USD	

Reinsurance: WBCIS weather insurance products have been well supported by national and international reinsurers, with an average of 50 per cent of the total coverage placed in the international market. The reinsurance contracts are based on a quota share/proportional treaty basis. In addition to the national reinsurer GIC Re, foreign reinsurers such as Paris Re, SCOR Re, Endurance Re and Swiss Re participate in the program.

Private Party Participation: Apart from the India Meteorological Department and state level agencies and international reinsurers, private parties involved in the delivery of WBCIS are independent data providers like (a) National Collateral Management Services Limited (NCMSL); (b) INGEN Technologies Pvt. Ltd. (c) Karnataka State Disaster Management Council (d) Tamilnadu Agriculture University and private insurers like ICICI Lombard, IFFCO Tokio, HDFC Ergo and Cholamandalam MS.

Chief Lessons learnt

- Real-time weather data through automation of manual weather stations
- Government financial support through subsidies
- Strong institutional network and delivery channels by enrolling insurance intermediaries, starting with insurance brokers, followed by corporate agents, and finally in 2008 micro-insurance agents
- Developing Stakeholder trust and understanding

TABLE 5 PROGRESS OF COVERAGE UNDER PILOT WEATHER BASED CROP INSURANCE SCHEME (WBCIS) IN INDIA (AS ON 25.07.2010)[26]

Note: INR to USD conversion rate as on Oct 2012 (1 INR= 0.019082 USD)

Season/ Year	Farmers Covered	Area covered (in Ha)	Sum Insured (INR in Mn)	Total Premium (INR in Mn)	Central Govt. Subsidy (INR in Mn)	Claims (INR in Mn)	Farmers benefitted	States Covered	
								No.	**Name**
Kharif 2007	43790	50075	530	703	281	524	35275	1	Karnataka
Rabi 2007-08	634636	984553	17389	14170	4892	10220	192727	4	Rajasthan, Bihar, Chhattisgarh, MP, Rajasthan
2007-08	678426	**1034628**	**17919** (341.93 Mn USD)	**14873** (283.81 Mn USD)	**5173** (98.71 Mn USD)	**10744** (205.02 Mn USD)	**228002**	**5**	
Kharif 2008	183481	221204	3511	3662.29	1344.11	1605.31	108975	10	M.P., Haryana, Punjab, Bihar, Rajasthan, Jharkhand, Orissa, Maharashtra, Karnataka & T.N.
Rabi 2008-09	192548	265439	5851	4686	1765.37	4781.22	120777	10	Bihar, **Chattisgarh**, Haryana, **Kerala,** Rajasthan, TN, Karnataka, **West Bengal,** Jharkhand &**Himachal Pradesh**
2008-09	376029	**486643**	**9362** (178.65Mn USD)	**8348.29** (159.30Mn USD)	**3109.48** (59.3488 Mn USD)	**6386.53** (121.87 Mn USD)	**229752**	**14**	
Kharif 2009	1160811	1566084	21147	21337	7672	15771	901749	13	Bihar, Haryana, Gujarat, Kerala, Rajasthan, TN, Karnataka, WB, Jharkhand, MP, Maharashtra, Orissa & AP
Rabi 2009-10	1082660	1862792	28024	23601	8983	12140	714618	11	Bihar, **HP**, Jharkhand, Rajasthan, TN, WB, Kerala, Karnataka, AP, Haryana, MP
2009-10	2243471	**3428876**	**49171** (938.30 Mn USD)	**44938** (857.53 Mn USD)	**16655** (317.821 Mn USD)	**27911** (532.61 Mn USD)	**1616367**	**14**	
Kharif 2010	3297926	4950147	76452	68159	24937	45042	2074121	16	AP, Bihar, Chattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Maharashtra, MP, Orissa, Rajasthan, TN, Uttarakhand, WB
2010-11	3297926	**4950147**	**76452** (1458.89 Mn USD)	**68159** (1300.64 Mn USD)	**24937** (475.86 Mn USD)	**45042** (859.51 Mn USD)	**2074121**	**16**	

[26] http://agricoop.nic.in/Credit/Progress%20of%20WBCIS%2021.pdf

Annexure III: Key Macro level comparison of some IBWI programs across the Globe:

	Municipalized Risk Group in Rio Grande do Sul, Brazil	WRMF index insurance pilot in China	Forage Rainfall Plan in Ontario, Canada	PepsiCo contract farming program in India	BASIX Index Insurance Program-India	Malawi - Weather Index Crop Insurance	Kilimo Salama[27][28] – Index-based Agriculture Insurance - Kenya
Crops insured	**Maize**	**Rice**	**Forage**	**Potatoes**	**Groundnut, castor and paddy**	**Groundnut**	**Maize and wheat**
Risks Covered	Drought, flooding and hail	Drought and high temperature	Drought	Late blight disease	Droughts	Drought	Drought and excess Rainfall
Index	Area-yield, with payouts triggered by 20% deviation from average regional yield	Drought and heat wave	Rainfall	Humidity and temperature	Rainfall	Rainfall	Rainfall, temperature, combined temperature/rainfall, humidity
Premium	11.09-17.10% of the sum insured	US$ 0.17 per 0.07 ha	Varies according to plan and subsidy	US$ 30/acre (1 acre = 0.405 ha). PepsiCo offers an incentive in the buy-back price of INR 0.15/kg (US$ 0.002/kg) with purchase of index insurance	Premium rates are 3-8 per cent of the sum insured	6-7% of sum insured	Farmers who buy Kilimo Salama buy it with fertilizer from MEA, seeds from Seed Co, and chemicals from Syngenta East Africa. Each time a farmer purchases the insurance, these companies match the premium contribution for their input.
Project Leads	Department of Agriculture and Supply (SAA), State Bank of Rio Grande do Sul (Banrisul), State Data-	IFAD-WFP Weather Risk Management Facility (WRMF), Ministry of Agriculture	Agriculture and Agri-Food Canada	PepsiCo, WRMS, ICICI Lombard	BASIX – a livelihood promotion social enterprise in India with technical assistance from Commodity Risk	The World Bank and Malawi's National Association of Small Farmers (NASFAM), Opportunity International Bank of	Syngenta Foundation for Sustainable Agriculture (SFSA), UAP Insurance, and telecoms operator Safaricom

27 Kilimo Salama –Index-based Agriculture Insurance, A Product Design Case Study by IFC

28 http://kilimosalama.wordpress.com/about/

	Municipalized Risk Group in Rio Grande do Sul, Brazil	WRMF index insurance pilot in China	Forage Rainfall Plan in Ontario, Canada	PepsiCo contract farming program in India	BASIX Index Insurance Program-India	Malawi - Weather Index Crop Insurance	Kilimo Salama[27][28] – Index-based Agriculture Insurance - Kenya
	Processing Company (PROCERGS) and Agro Brasil Seguros				Management Group (CMRG)	Malawi, Malawi Rural Finance Corporation	
Beneficiaries	Small, low-income family farms (less than 80 ha) that earn at least 70% of total family income from agriculture	Rice farmers in Changfeng County, Anhui Province	Producers of forage in Ontario	Potato farmers participating in PepsiCo contract farming	Small, low income farmers in the Indian state of Andhra Pradesh	Farmers	all Kenyan farmers, independent of farm size
Insurer	PROAGRO	Guoyuan Agricultural Insurance Company (GAIC)	AgriCorp	ICICI Lombard (insurer) and WRMS (technical and infrastructure support)	ICICI Lombard and BASIX	Insurance Association of Malawi	UAP Insurance Ltd
Weather data provider	Brazilian Institute of Geography and Statistics	Anhui Meteorological Service	Environment Canada	WRMS	WRMS	Malawi National Met Services	Kenya Meteorological Department
Regulator	SUSEP	Chinese Insurance Regulatory Commission (CIRC)	Canadian Council of Insurance Regulators	Insurance Regulation and Development Authority (IRDA)	IRDA	Reserve Bank of Malawi	Insurance Regulatory Authority (IRA)
Outreach	26,071 in 2007 and 14,893 in 2008	482 farmers in 2009	1,945 in 2008	4,250 in 2007 and 4,575 in 2008	Cumulatively till 2010, 39,864 policies sold and 11,950 claims settled	2005: 892 farmers 2008: 2,600 farmers	over 70,000 farmers
Lessons learnt	• No need for upfront payment of the premium; • Strong marketing strategy;	• Need of improving client understanding and trust • Sustainability of	• Product review and improvement from time to time to better suit the needs of the forage	• Consistent daily data collection difficult due to variations in weather	• BASIX improved the weather insurance products based on farmer feedback and trained their	• Thorough explanation of product concepts to stakeholders and thus winning the	• Rainfall measurement must be objective: Use of solar powered weather stations in case of Kilimo Salama.

	Municipalized Risk Group in Rio Grande do Sul, Brazil	WRMF index insurance pilot in China	Forage Rainfall Plan in Ontario, Canada	PepsiCo contract farming program in India	BASIX Index Insurance Program-India	Malawi - Weather Index Crop Insurance	Kilimo Salama[27][28] – Index-based Agriculture Insurance - Kenya
	• Successful use of technology; and • Wider approach to rural and agricultural development	financial subsidies • Weather data structure and availability of data • Capacity-building of local stakeholders	producers. • It is a single-peril index insurance that is relatively easy to implement. • Limited in its replicability as it is implementable in regions that have adequate rainfall collection stations.	indicators in short intervals of time and lack of sufficient infrastructure. • Chances of basis risk as most weather stations are not located in poor rural areas • Limited participation of reinsurance companies	staff accordingly, as a result of which the outreach of the program expanded substantially w.r.t. to number and area. • BASIX's work also catalyzed the weather insurance market in India.	confidence of the farmers. • Attractive pricing of the produce. • Committed stakeholders (WB,OIBM,IAOM,NASFAM,MET OFFICE, MRFC) • Early involvement of field staff. • Milestone schedules. • Documents in place – manual, client information sheet and contract monitoring sheets.	• Establish a local distribution channel: Kilimo Salama is distributed using local stockists at the time of purchasing inputs, making it easier for the customer to adopt the new product • Mobile banking is a useful delivery tool: The use of Safaricom's M-PESA system was key to Kilimo Salama's success

Annexure IV: Lessons learned from the Successful Meso and Micro level Index Based Insurance Models

Program Name	Lesson Learned
Weather Based Crop Insurance Scheme of India (WBCIS)	• Products can be offered on newly installed stations without unduly increasing the basis risk for insurer • Subsidies can help expedite infrastructure development for Index Insurance • Large market size can help in obtaining flexible reinsurance terms from the reinsurers
Municipalized Risk Group in Rio Grande do Sul, Brazil	The four elements which made this programme successful and replicable are as follows: • No need for upfront payment of the premium • Strong marketing strategy • Successful use of technology • Wider approach to rural and agricultural development
PepsiCo contract farming program in India	• Contract farming company can participate in insurance process by incentivizing insured farmers during output buying • Index insurance can reduce the supply chain risk of contract farming company and also helps company in retaining its contract farmer base • By linking itself to robust contract farming model, Index Insurance doesn't have to address risk relating to poor farming practices
Malawi - Weather Index Crop Insurance	• Index-based weather insurance is not a panacea. It is necessary to raise awareness of the limited role that weather insurance has in managing the larger spectrum of risks farmers face and to control these risks as much as possible within the program • Effective index-based weather insurance contracts require reliable, timely, and high quality data weather station networks • An enabling legal and regulatory framework is necessary for the expansion of the program • Client/stakeholder education and outreach is essential to establish successful micro-level insurance programs
BASIX Index Insurance Program	• BASIX given focus on the customer education and staff capacity building to make the Weather Based Crop Insurance Scheme a successful and sustainable program. Over a period of time the products has been improved based on farmer feedback and made available the enhanced products from time to time, as a result of which the outreach of the program expanded substantially w.r.t. to reach in both number and geographies • BASIX's work also catalyzed the weather insurance market in India
Kilimo Salama – Index-based Agriculture Insurance - Kenya	• Micro-insurance products should rely on objective measurements for product reliability. Kilimo Salama uses innovative, solarpowered weather stations that give accurate rainfall measurements and also communicate other useful data for farmers. • Establishing local distribution channel makes it easier for the customer to adopt the new product • Mobile banking is a useful delivery tool; It allowed the product to reach farmers with little infrastructure requirement and provided easy access for every transaction

Annexure V: Key Lessons on WII for Zambia

Focus Area	Description
Background of crop insurance/disaster relief is necessary	Both Indian and Mexican governments had experience of more than 20 years on area-yield based crop index insurance and state sponsored disaster relief programs. Both were looking for mechanisms to improve the existing programs in terms of re-insuring the risks and expediting claim settlements. They substituted existing programs with IBWI. Without the massive prevailing crop insurance/ disaster relief tradition and infrastructure which existed in both the countries, scaling up of IBWI to the present level would have been difficult.
Meteorological Infrastructure is necessary	A very granular meteorological infrastructure is necessary to reduce basis risks in claim settlements. Unless the insurance products pay adequately and fairly when there are crop losses, the schemes cannot be scaled up.
Premiums should be affordable	In several cases, the premiums which farmers can afford do not match up to the actuarial premiums of the desired insurance coverage. This mismatch severely affects scalability and in such cases the deficit in the premium may be met by other entities in the agricultural value chain (e.g. input suppliers or procurement agencies for whom farmer's sustainability is strategically crucial) or the government.
Field partners	Lot of effort is required towards educating the farmers on the IBWI product. An institution on the ground has to constantly hand hold the farmers over 2-3 seasons till the farmers understand the product and the claim settlement processes. Experience worldwide suggests that information dissemination takes time and hence requires an active engagement with field partners for years. Therefore agencies that engage with farmers on various aspects of farming and have a revenue model based on multiple farm level services (rather than just IBWI alone) prove more useful and sustainable.

Annexure VI: Agriculture insurance products in Zambia

TABLE 6 TYPES OF AGRICUTURAL INSURANCE PRODUCTS

Name of company	**Type of product offered**	**Risks covered**	**Remarks**
Company D	Damage based	• Damage due to fire, lightning, storm, malicious damage, transit and theft of harvested crop, damage by animals	Risk cover for harvested Crops whilst stored.
Company F	Damage based	• Damage due to fire, lightning, storm, malicious damage, transit and theft of harvested crop, damage by animals • Separate covers for hail	Risk cover from harvest to auction.
Company H	Damage based	• Damage due to fire, lightning, storm, malicious damage, transit and theft of harvested crop, damage by animals,	Risk cover for harvested Crops whilst stored.
Company E	Damage based	• Damage due to fire, lightning, storm, malicious damage, transit and theft of harvested crop, damage by animals • Separate covers for hail	Risk cover for harvested Crops whilst stored.

Annexure VII: Overview of Zambia

TABLE 7 SOCIOECONOMIC SNAPSHOT OF ZAMBIA

Key Socioeconomic Indicators[29][30]	
Population	13.5 Mn (as on yr 2011)
Surface area (sq. km) (thousands)	752.6
Gross national Income (GNI) per capita, PPP (current international $)	1490
Gross Domestic Product (GDP) at current prices	US$ 19.21 Bn
GDP per capita (current US$)	US$ 1,425
GDP per capita (PPP)	US$ 1600
GDP growth rate (annual)	2009- 6.4% 2010- 7.6% 2011- 6.6% 2012**- 5.9%**
Gini coefficient[31]	0.60 in year 2006
Human Development Index	0.430
Debt to GDP ratio	22.8 (Yr. 2010)
GDP by Sector	agriculture: 21% industry: 38% services: 42%
Distribution of Labour Force across Sectors	Agriculture Labour= 85% Industrial Labour= 6% Other Labour= 9% (2004)
Balance of Payments (2011, in Mn USD)	Exports of goods and services= 9047 Import of goods and Services= 7647.26 Current Account Balance = 215.388 Reserves of foreign exchange and gold: $2.953 billion (31 December 2011 est.)
Other Indicators	
Life expectancy at birth, total (years)	49.0
Mortality rate, infant (per 1,000 live births)	52.7
Literacy rate, youth female (% of females ages 15-24)	67.3
Prevalence of HIV, total (% of population ages 15-49)	13.5

[29] http://web.worldbank.org

[30] http://www.tradingeconomics.com/zambia

[31] The gini coefficient for Zambia in 2006 was 0.60, a decline from 0.61 percent in 1996. It was 0.54 in the rural households and 0.66 in the urban households. This reveals that the income inequalities in 2006 were more pronounced in the urban areas than in the rural areas. *(http://www.zambian-economist.com)*

TABLE 8 GEOGRAPHICAL, DEMOGRAPHICAL AND CLIMATIC FEATURES OF ZAMBIA

ZAMBIA	
Geography	
Location	Southern Africa, east of Angola, south of the Democratic Republic of the Congo
Country overview	Capital- Lusaka, Provinces- 10, Districts- 72
Area	Total: 752,618 sq km land: 743,398 sq km water: 9,220 sq km
Coastline	0 km (landlocked)
Season	tropical; modified by altitude; rainy season (October to April)
Terrain	mostly high plateau with some hills and mountains
Land Use	arable land: 6.99% permanent crops: 0.04% other: 92.97% (2005)
Irrigated Land	1,560 sq km (2008)
Demography	
Population (2011)	13.5 Mn (40% Urban, 60% Rural)
Population density (2010)	18 people per sq. Km
Population Growth rate	2.8% (Average Annual Population Growth rate between 2000 – 2010)
Climate	
Natural Hazards	periodic drought; tropical storms (November to April), Flood
flood prone areas	Kafue, Zambezi and Luangwa river basins
drought prone areas	Southern/south eastern Zambia
Economy	
Agriculture Products	**Crops:** corn, sorghum, rice, peanuts, sunflower seed, vegetables, flowers, tobacco, cotton, sugarcane, Cassava (tapioca), coffee; **Livestock:** cattle, goats, pigs, poultry, milk, eggs, hides
Industries	Copper mining and processing, construction, foodstuffs, beverages, chemicals, textiles, fertilizer, horticulture

Source: http://www.zamstats.gov.zm/media/agr_rpt.pdf

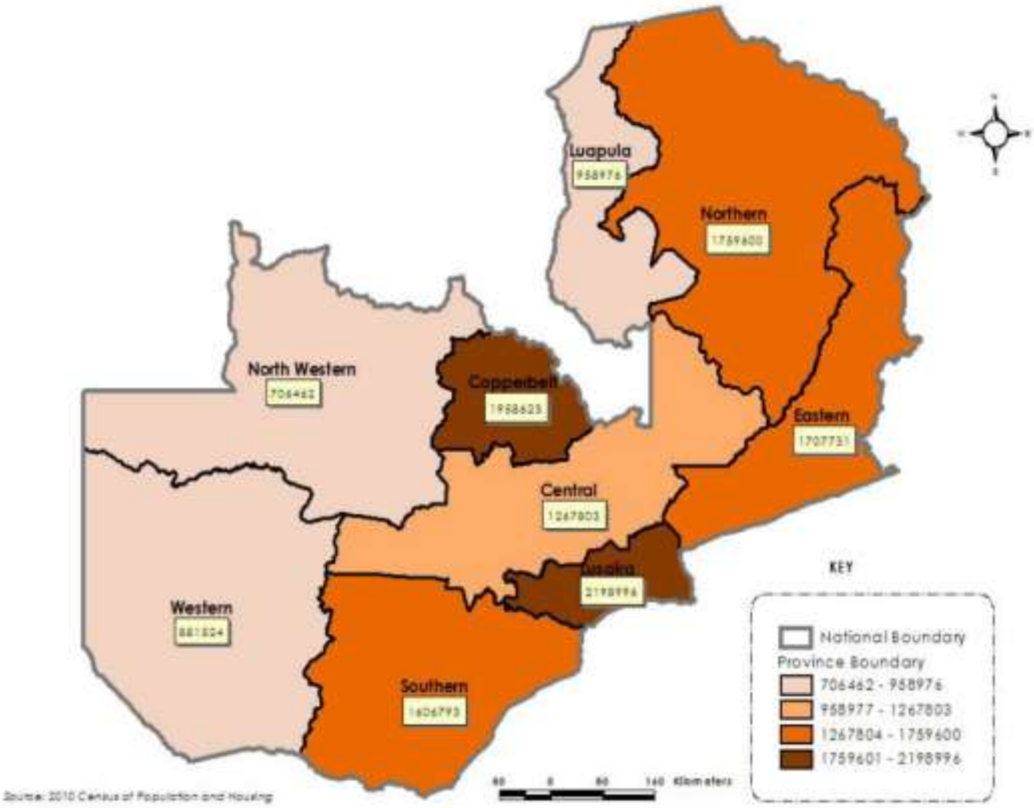
FIGURE 2 PROVINCES OF ZAMBIA[32]

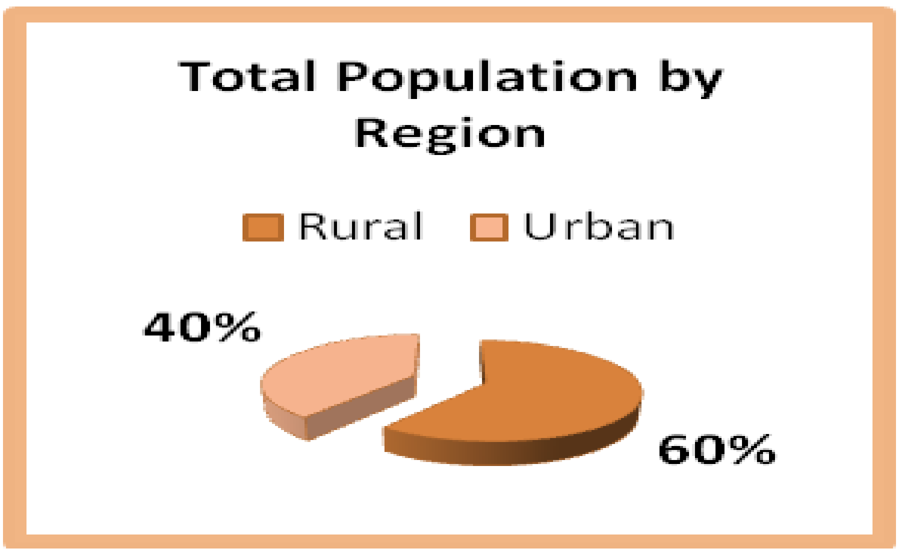
TABLE 9 THE CAPITAL CITY AND DISTRICTS FALLING UNDER EACH PROVINCE OF ZAMBIA

Province	Capital	Districts	Districts
Central	Kabwe	6	Chibombo, Kabwe, Kapiri-Mposhi, Mkushi, Mumbwa, Serenje
Copperbelt	Ndola	10	Chililabombwe, Chingola, Kalulushi, Kitwe, Luanshya, Lufwanyama, Masaiti, Mpongwe, Mufulira, Ndola
Eastern	Chipata	7	Chadiza, Chipata, Katete, Lundazi, Mambwe, Nyimba, Petauke
Luapula	Mansa	7	Chienge, Kawambwa, Mansa, Milenge, Mwense, Nchelenge, Samfya
Lusaka	Lusaka	4	Chongwe, Kafue, Luangwa, Lusaka
Muchinga	Chinsali	6	Chama, Chinsali, Isoka, Mafinga, Mpika, Nakonde
Northern	Kasama	8	Chilubi, Kaputa, Kasama, Luwingu, Mbala, Mporokoso , Mpulungu, Mungwi
North-Western	Solwezi	8	Chavuma, Ikelenge, Kabompo, Kasempa, Mufumbwe, Mwinilunga, Solwezi, Zambezi
Southern	Livingstone	11	Choma, Gwembe, Itezhi-tezhi, Kalomo, Kazungula, Livingstone, Mazabuka, Monze, Namwala, Siavonga, Sinazongwe
Western	Mongu	7	Kalabo, Kaoma, Lukulu, Mongu, Senanga, Sesheke, Shang'ombo
Zambia	**Lusaka**	**74**	

[32] (MAP is showing only nine provinces of Zambia. Muchinga province was separated from Northern Province in 2011.)

FIGURE 3 POPULATION DISTRIBUTION BY PROVINCE, ZAMBIA, 2010





Source: 2010 CENSUS OF POPULATION AND HOUSING PRELIMINARY REPORT

Annexure VIII: Agro-ecological Regions of Zambia

Zambia is divided into 28 agro-ecological zones , which are further grouped in three main zones, mainly on the basis of rainfall.

FIGURE 4 AGRO ECOLOGICAL REGIONS OF ZAMBIA

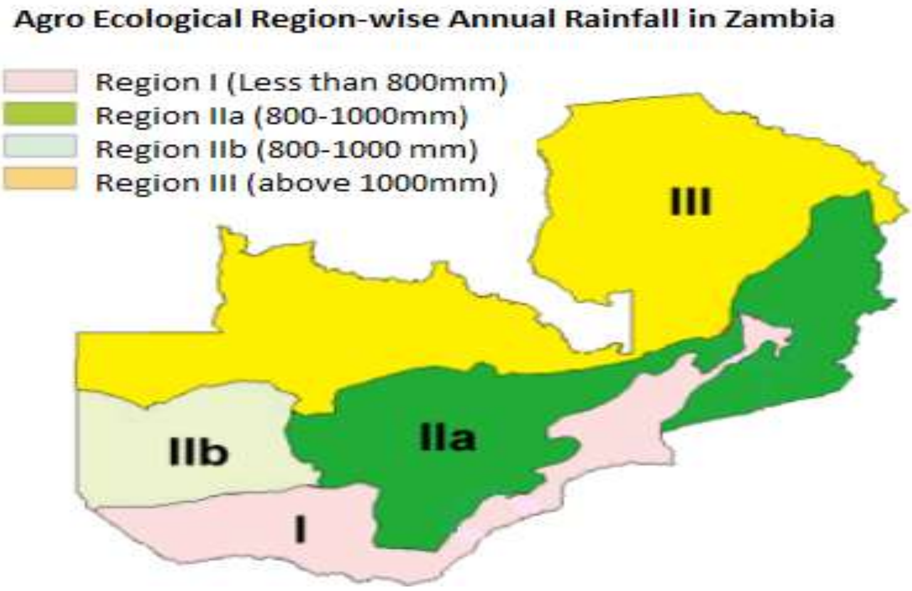


FIGURE 5 LIVELIHOOD ZONES OF ZAMBIA

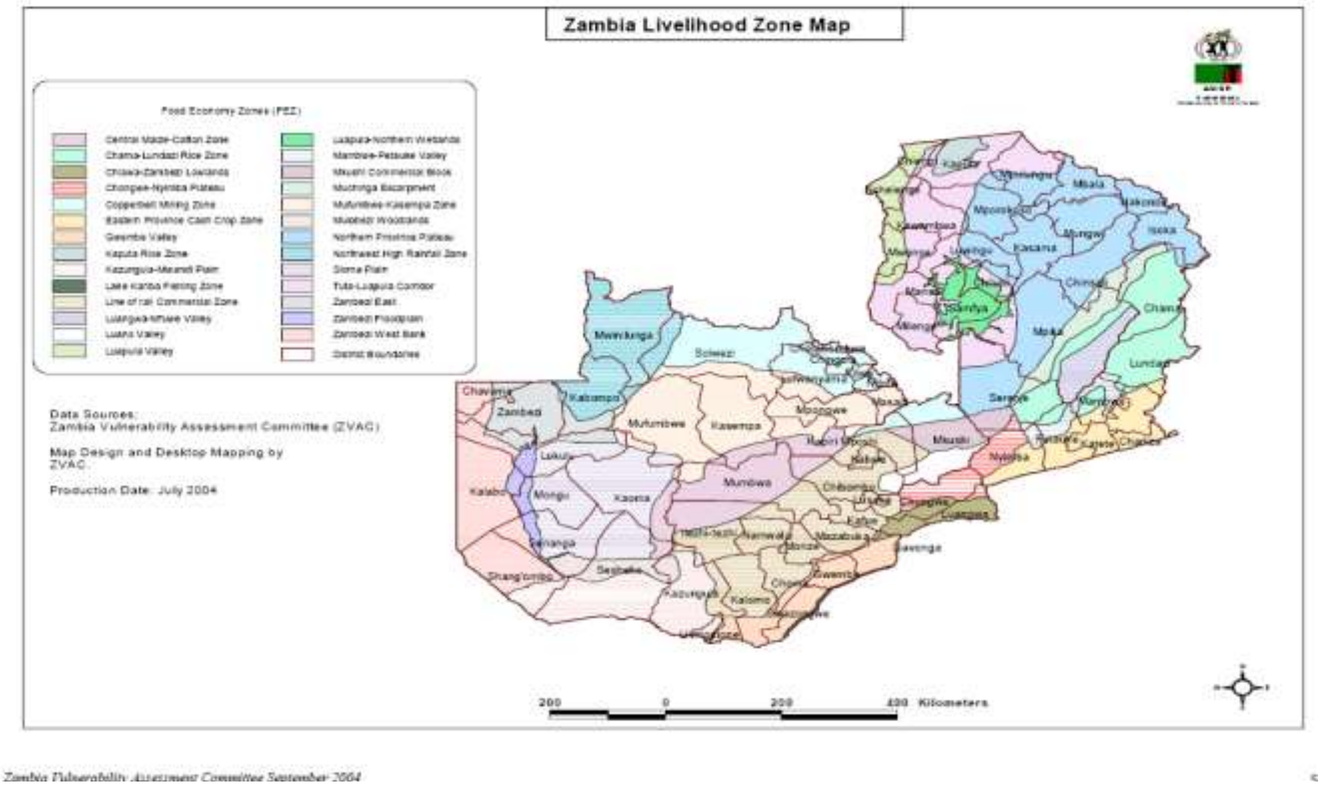


TABLE 10 KEY CHARACTERISTICS OF ZAMBIA'S AGRO-ECOLOGICAL REGIONS

Agro Ecological Regions	Avg. rainfall (mm/ Year)	Min. (Dec - Feb)	Elevation (meters)	Growing Season (days)	Risk of Drought	Occurrence of Frost in Dry Season	Agricultural Importance
Region I	< 800mm	19 – 21	300 - 900; 900 - 1,200	80 – 129	Medium to High	Risk in Plateau Areas	Suitable for production of small grains and livestock rearing
Region II a	800 - 1,000 Mm	17 – 18	900 - 1,300	100 – 140	Medium to Low	Risk in the Central Plateau	Most productive areas in the country in both food and cash crops
Region II b							High potential for Cassava and rice production as well as cattle rearing
Region III	> 1,000 mm	14 – 16	1,100 - 1,700	120 - 150	Very Low	Some risk in the South-West	High Cassava growing and consuming region

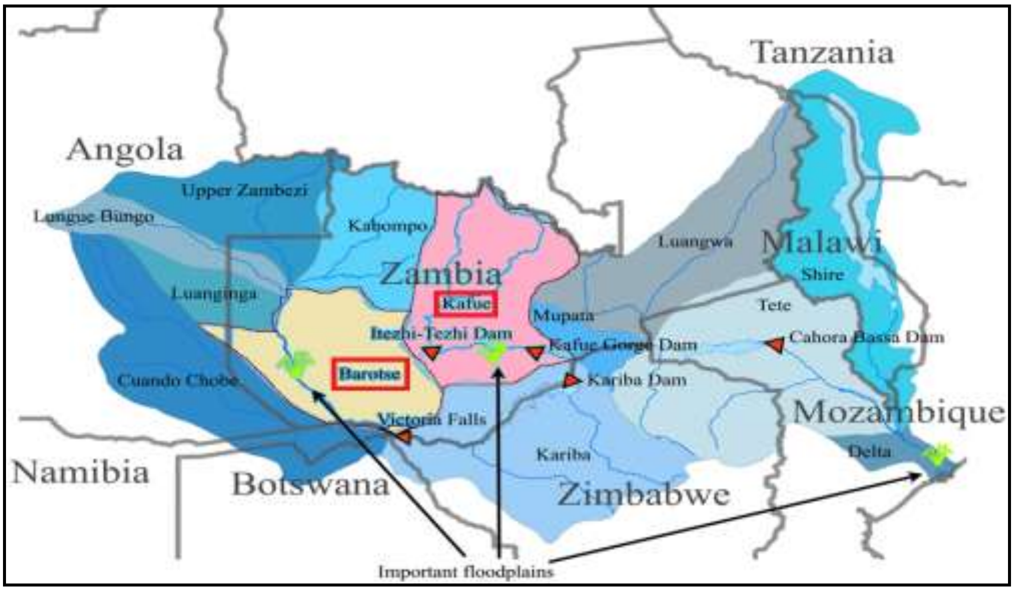
Source: Institute for African Studies (1996). Agricultural Sector Performance Analysis, IAS, University of Zambia, Lusaka

TABLE 11DESCRIPTION OF SOIL- REGION WISE

Region	General Description of Soils	Limitations to Crop Production
Region I	Loamy and clay with course to fine tops	Slightly acidic to alkaline. Minor fertility limitations
	Reddish coarse sandy soils	Low pH, available water & nutrient capacity reserve
	Poorly drained sandy soils	Severe wetness, acidic & low fertility
	Shallow & gravel soils in rolling to hilly areas including escarpment zones	Limited depth & unsuitable for cultivation
Region II	Moderately leached clayey to loamy soils	Low nutrient reserves & water holding capacity
	Slightly leached clayey soils	Slight to moderate acidity. Difficult to work due to heavy textured soil.
	Coarse sandy loams in large valley dambos	Imperfectly to poorly drained. Limitations due to wetness
	Sandy soils on Kalahari sand	Medium to strong acidity, course textured top soil, low water holding capacity and nutrient reserves
Region III	Red to brown clayey loamy soils	Very strong acidity and strongly leached
	Shallow and gravel soils in rolling hilly areas	Limited depth
	Clayey soils, red in colour	Moderately to strongly leached. Fewer limitations
	Poorly to very poorly drained flood plain soils	Variable texture and acidity
	Course sandy soils in pan dambos on Kalahari sand	Very strong acidity

Source: Compiled from A. Bunyolo, B. Chirwa and M. Muchinda •Agro-ecological and Climatic Conditions• in Stephen W. Muliokela (ed.), 1995: Zambia Seed Technology Handbook, Ministry of Agriculture, Food and Fisheries, Lusaka

Annexure IX: Location of Kafue and Barotse River Sub-Basins in Zambia



Source: *http://www.ied.ethz.ch/newsletter/newsletter10/research/ir*

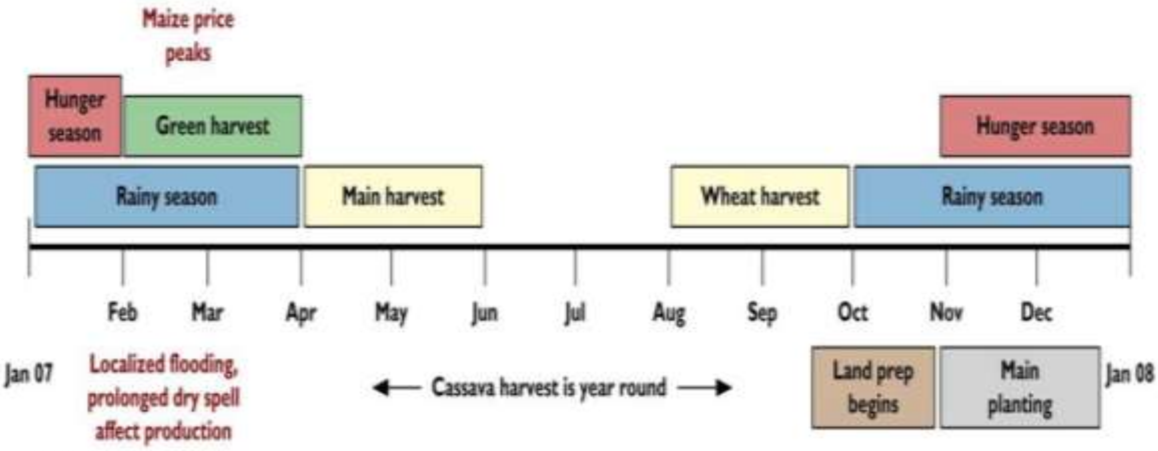
Annexure X: Natural Disasters Reported in Zambia

Disaster	Year	People Affected
Drought	1991	1,700,000
Flood	2007	1,400,000
Flood	1998	1,300,000
Drought	1995	1,273,204
Drought	2005	1,200,000
Flood	1989	800,000
Flood	2001	617,900
Flood	2009	614,814
Flood	2004	196,398
Flood	2007	118,755

Source: *http://www.preventionweb.net/english/countries/statistics/?cid=192*

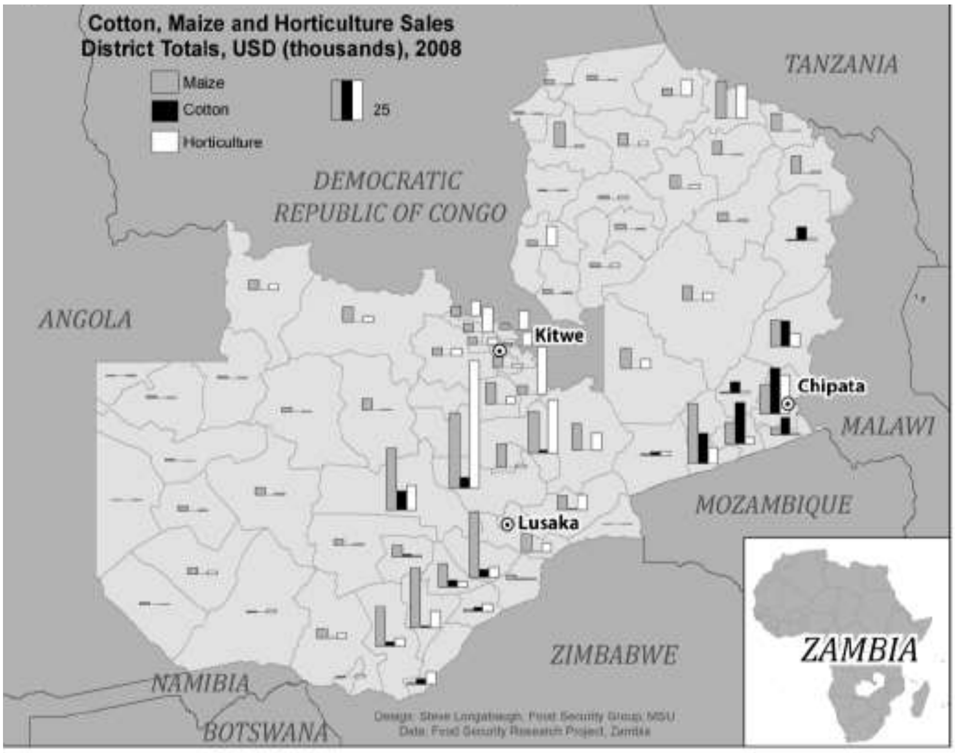
Annexure XI : Agriculture in Zambia

FIGURE 6 AGRICULTURE CALENDAR



Source: FEWS NET

FIGURE 7 GEOGRAPHIC DISTRIBUTION OF MAIZE, COTTON AND HORTICULTURE SALES



Source: Post Harvest Survey of 2008.

Production of major crops and area under production in Zambia

FIGURE 8 AREA UNDER MAJOR CROPS[33]

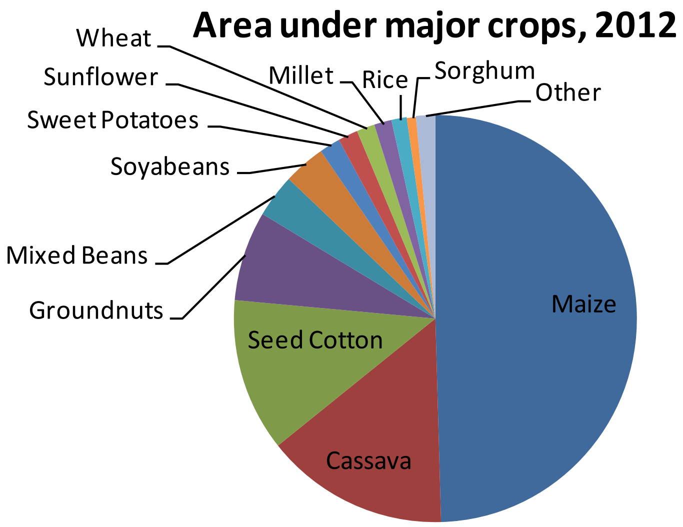
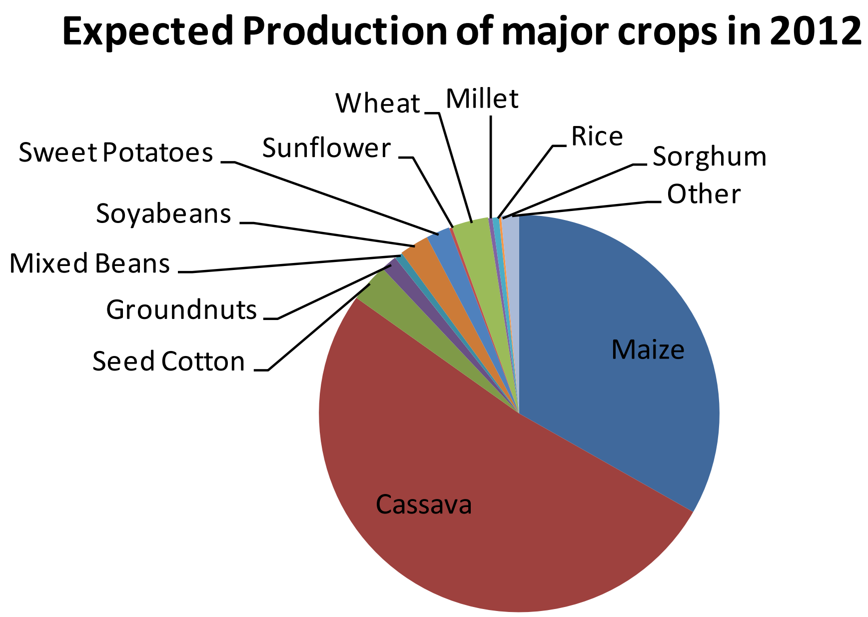


FIGURE 9 EXPECTED PRODUCTION OF MAJOR CROPS IN 2012[34]



[33] Ministry of Agriculture and Livestock, Central Statistical Office (CSO)
[34] Ministry of Agriculture and Livestock, CSO

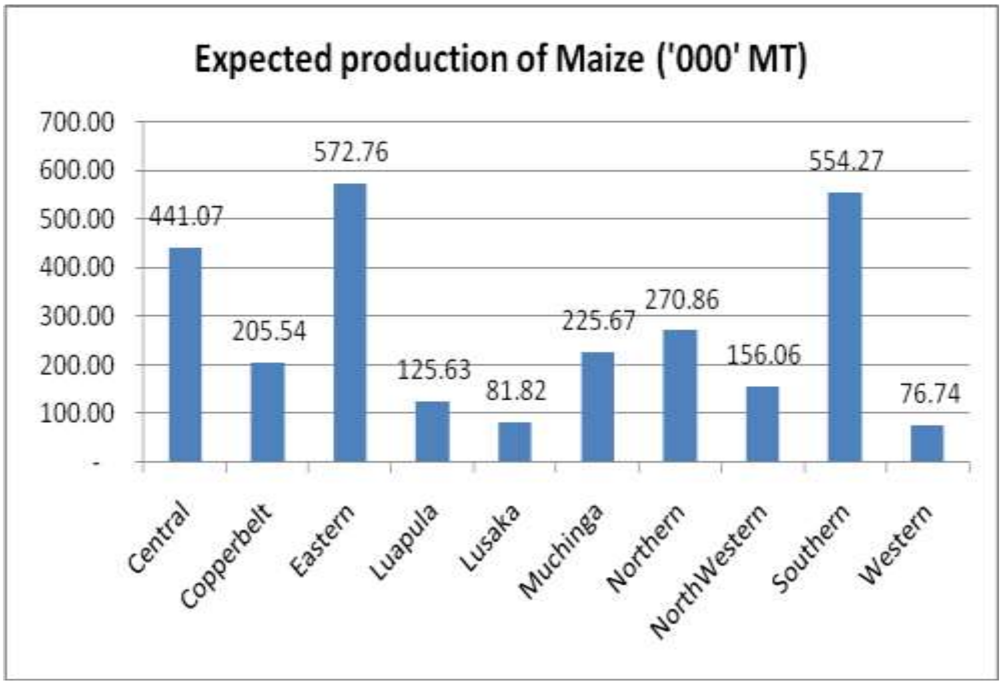
TABLE 12 AREA, PRODUCTION, YIELD, ESTIMATES OF MAJOR CROPS (MAIZE, SEED COTTON) IN ZAMBIA AS PER 2011/2012 CROP FORECAST SURVEY

Crop	Province	Area planted (Ha)	Area Harvested (Ha)	Expected production (MT)	Yield (MT/Ha)
Maize	Central	1,73,174	1,45,636	4,41,073	2.55
	Copperbelt	89,501	79,359	2,05,542	2.30
	Eastern	2,76,288	2,45,319	5,72,760	2.07
	Luapula	45,930	42,195	1,25,635	2.74
	Lusaka	33,760	29,991	81,825	2.42
	Muchinga	69,764	65,286	2,25,668	3.23
	Northern	98,402	93,991	2,70,858	2.75
	NorthWestern	64,299	60,305	1,56,055	2.43
	Southern	3,03,429	2,27,076	5,54,275	1.83
	Western	91,108	57,025	76,740	0.84
	Total	**12,45,656**	**10,46,183**	**27,10,431**	**2.18**
Seed Cotton	Central	67,937	64,580	53,112	0.78
	Copperbelt	605	605	785	1.30
	Eastern	1,90,607	1,84,472	1,60,956	0.84
	Lusaka	2,652	2,610	2,494	0.94
	Muchinga	10,180	9,000	16,292	1.60
	Southern	40,380	36,460	33,417	0.83
	Western	731	731	871	1.19
	Total	**3,13,093**	**2,98,458**	**2,67,926**	**0.86**

TABLE 13 AREA, PRODUCTION, YIELD, ESTIMATES OF CASSAVA AS PER 2011/2012 CROP FORECAST SURVEY

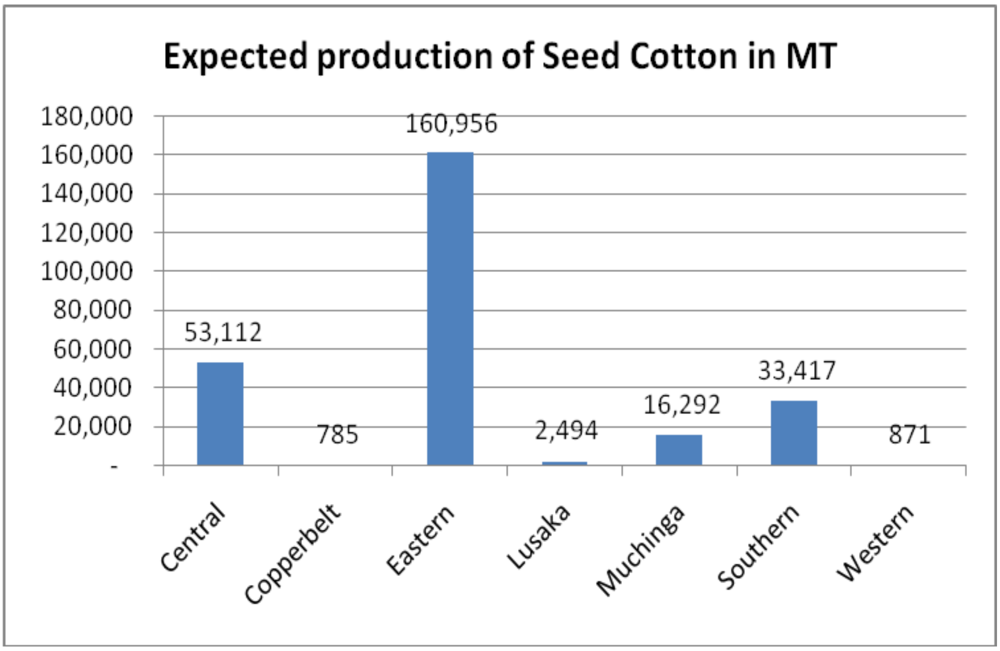
Province	Area under cassava	Area under mature cassava	Number of households growing crop	Cassava root production 11.7 mt/ha	Conversion to flour 25% extraction rate
Central	14,366	7,057	37,587	1,68,077	42,019
Copperbelt	2,751	1,268	10,031	32,185	8,046
Eastern	1,494	727	6,638	17,482	4,371
Luapula	1,13,602	41,959	3,26,360	13,29,145	3,32,286
Lusaka	265	46	1,097	3,099	775
Muchinga	39,570	15,982	1,07,204	4,62,964	1,15,741
Northern	1,12,795	41,253	3,16,025	13,19,701	3,29,925
NorthWestern	44,393	15,585	1,12,108	5,19,401	1,29,850
Southern	263	75	1,114	3,083	771
Western	48,152	28,942	92,334	5,63,382	1,40,846
Total	3,77,651	1,52,895	10,10,496	44,18,519	11,04,630

FIGURE 10 PROVINCE-WISE EXPECTED PRODUCTION OF MAIZE IN 2012 IN MT



Source: CSO 2011/2012 Crop Forecasting Survey

FIGURE 11 PROVINCE-WISE EXPECTED PRODUCTION OF SEED COTTON IN 2012 IN MT



Source: CSO 2011/2012 Crop Forecasting Survey

Annexure XII: Natural Catastrophies reported in Kafue and Barotse, their impact on Agriculture and livelihoods and coping mechanisms followed

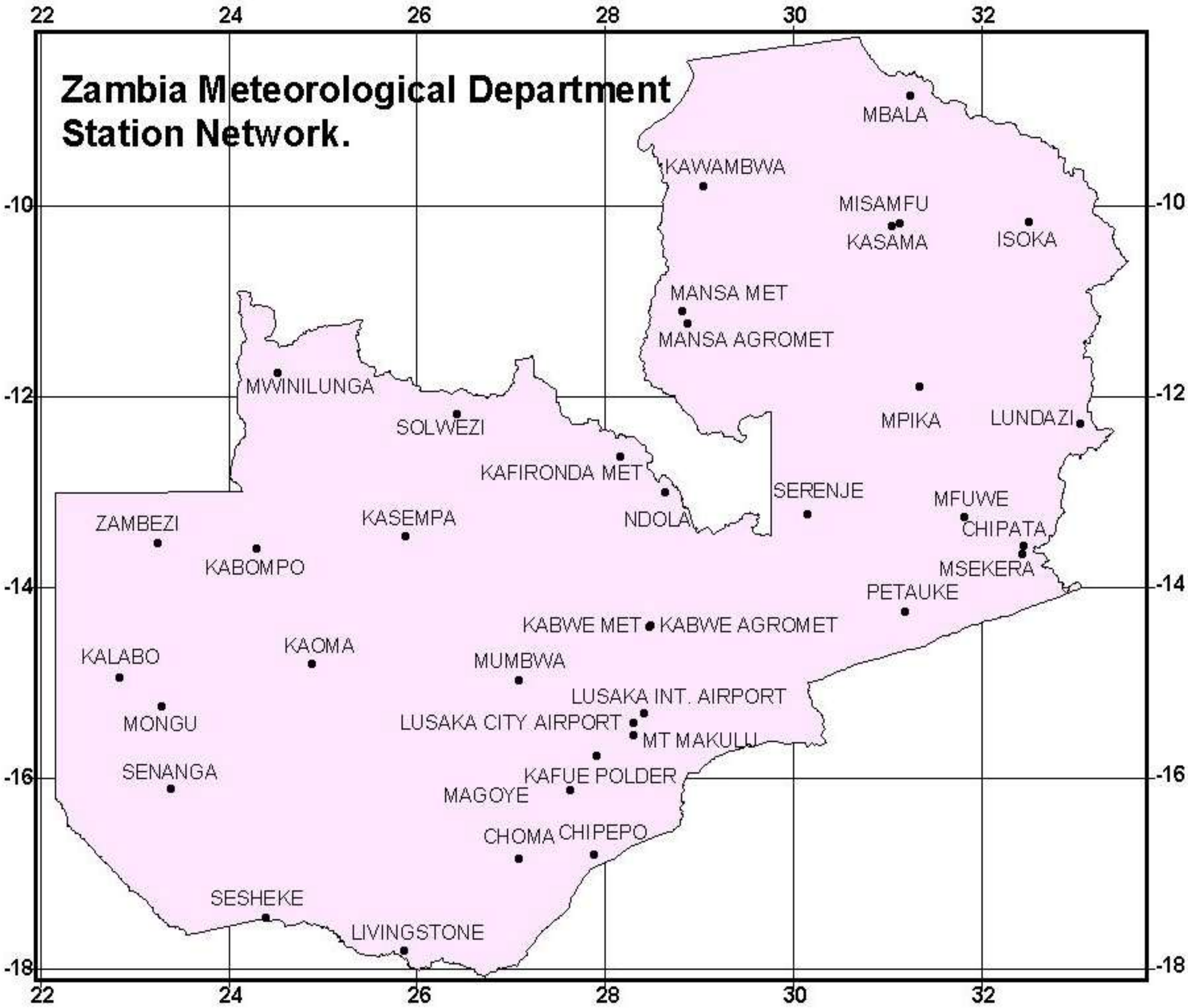
TABLE 14 TYPES OF WEATHER AND LIVESTOCK RELATED CATASTROPHIC DISASTERS AFFECTING LIVELIHOODS

Regions	Worst crop related catastrophic event ever	Worst livestock related catastrophic event ever	Crop weather related event since 2000	Livestock related event since 2000
Kafue	- Floods 2009-2011 - Drought 2011 - Occasional flooding - No rain and flooding in short intervals	- Corridor disease (2012-2011)	- Floods: 2011 - Draught: 2011	- Human Animal Conflict
Barotse	- Several floods 2009-2011 - Droughts - Unpredictable rainfall pattern - Irrigation canals blocked by sand - 2010 cold weather affecting cassava, cashew nuts and mango outputs - Low rain levels in 2010/ 2011.	CBPP (cattle disease) killing cattle in large numbers	- 2002 drought combined with hailstorm - Low rainfall of the last 2 years	

TABLE 15 RISK MANAGEMENT MEASURES

Regions	Preventive measures	Short term responses to shock	Long term responses to shock
Kafue	– Cotton and banana production – Use of different maize seed (GV412) – Early maturing seed – Rearing of goats. – Crop diversification – Gardening near the river	– Selling of livestock (cattle and goats) – Gardening – Winter-maize to sell for some extra income. – Work at the Zambeef Company – Collection of wild food and berries in case of food shortage – Government food rations – Borrowed money to do some business – Part-time work for cash – Crushing stones	– Gardening – Applying for government food rations (distributed in Nov. and Dec)
Barotse	– Crop diversification (but with little knowledge and poor assistance from Govt.) – Early maturing varieties so that harvest happens before the regular floods to the area – Request for "soft loans" easy to get without collaterals – Careful schedule of planting	– Off farm labour: construction, fishing, carpentry – Irrigation – Unblocking of irrigation canals from sand – Overhead irrigation for maize (but this require cash investment so only few adopted it) – Level land for rice labour (but this require cash investment so only few adopted it)	– Complaints to administration officials – Irrigation project funded by Japanese Govt. – Continuing unblocking of irrigation canals, but regularity of labour has proven difficult – Early planting

Annexure XIII: Location of meteorological stations in Zambia



Source: Presentation by Mr. Oversease A. Mwangase, Deputy Director, Meteorological Dept. Zambia

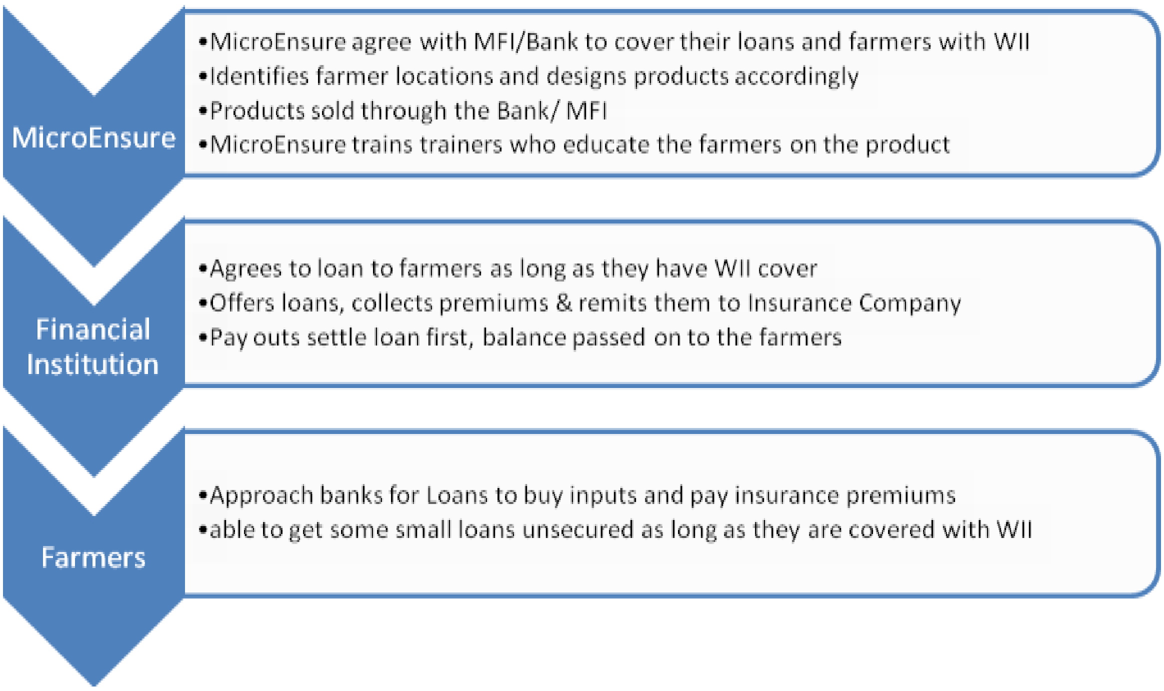
Annexure XIV: Learning from MicroEnsure's marketing and distribution model in Africa

Access to finance has for long been identified as one of the main challenges the smallholder farmers face in Africa. Smallholders are frequently unable to access financial services, as banks are reluctant to lend money due to the potential for default due to crop failure; and the financial institutions that have managed to lend out, have always asked for 125%- 150% as collateral for the loans. The result has been chronic underinvestment in the sector; however, insurance against such risks facilitates access to credit for smallholders. This has influenced the farmers and condemned them to use rudimental methods of farming including using seeds that are of poor quality.

MicroEnsure's model used in Africa was derived from this existing challenge in the various countries and it aimed at reducing the weather risk component for the financial institutions there by lessening the collateral required for agriculture loans. This allows them to purchase improved farm inputs such as high quality seeds and appropriate fertilizers, therefore improving crop yields, food security and the development of the rural economy.

MicroEnsure works closely with financial institutions that are willing to give credit to the farmers and provides the insurance. In this model as seen below, some access to finance has been achieved.

FIGURE 12 MICROENSURE'S MAKETING AND DISTRIBUTION MODEL IN AFRICA



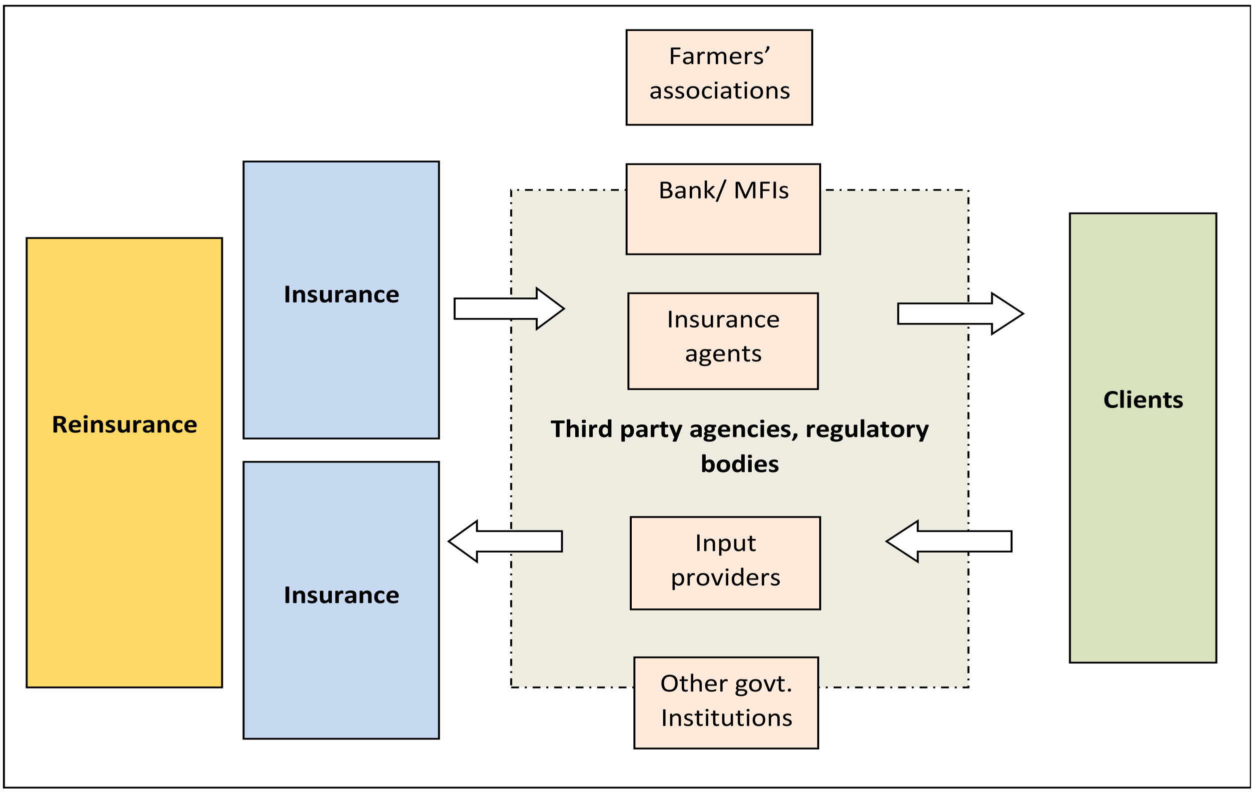
With the achieved access to finance, MicroEnsure is changing the model and is looking at collaborating with various stakeholders in the agriculture sector and together they provide insurance to their target farmers. A down up approach is being adopted where MicroEnsure will work closely with the farmer groups and organizations and link them to other service providers in order for them to get all the required services and at the right price. In this new model, MicroEnsure will have a close relationship with the farmers and this will enable the provision of insurance to even farmers groups that will not need credit from financial institutions. The farmer will be at the centre between MicroEnsure and other stakeholders, and the farmer needs will determine the various partnerships MicroEnsure can have.

Annexure XV: Index Insurance value chain

TABLE 16 ROLE OF DIFFERENT INSTITUTIONS IN A VIBRANT INDEX INSURANCE ECOSYSTEM IN ZAMBIA

Institutions	How to engage them and create a vibrant Ecosystem for Index Insurance
Insurance companies	Can Include index insurance covers as part of their standard Crop Insurance (MPCI, including Fire and theft) schemes. Assist them to design and market these products to their existing customer base Provide index insurance covers for small growers (to reduce administrative costs)
Govt	Provide index insurance for small growers as safety net Improve the weather monitoring infrastructure Access to FRA/FISP outreach
Out-growers/Banks	Design products according to their requirements, which can be integrated with their schemes (to work with Company C, Company A). Make them tie up with Insurers
Distributors	Agencies who can work on behalf of insurance companies to reach out to commercial growers (Low-High-Road takers). Zambia has a good ecosystem of input dealers traders and procurers who are reaching out to commercial farmers
Data Providers	Identify agencies who can install a network of weather stations and/or gather data from satellites to supply data for claim settlement to insurers. These need to work in tandem with the Zambian Met Agency. Need to check investment viability

FIGURE 13 INSURANCE VALUE CHAIN



Annexure XVI: The proposed captive arrangement of reinsurance fund and its functioning

FIGURE 14 CAPTIVE ARRANGEMENT

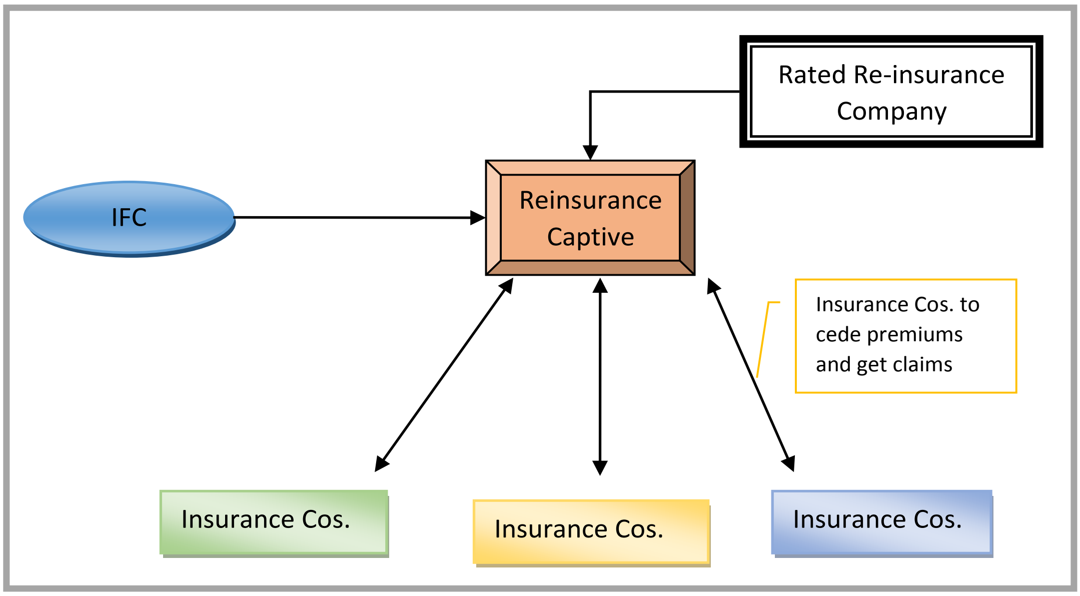


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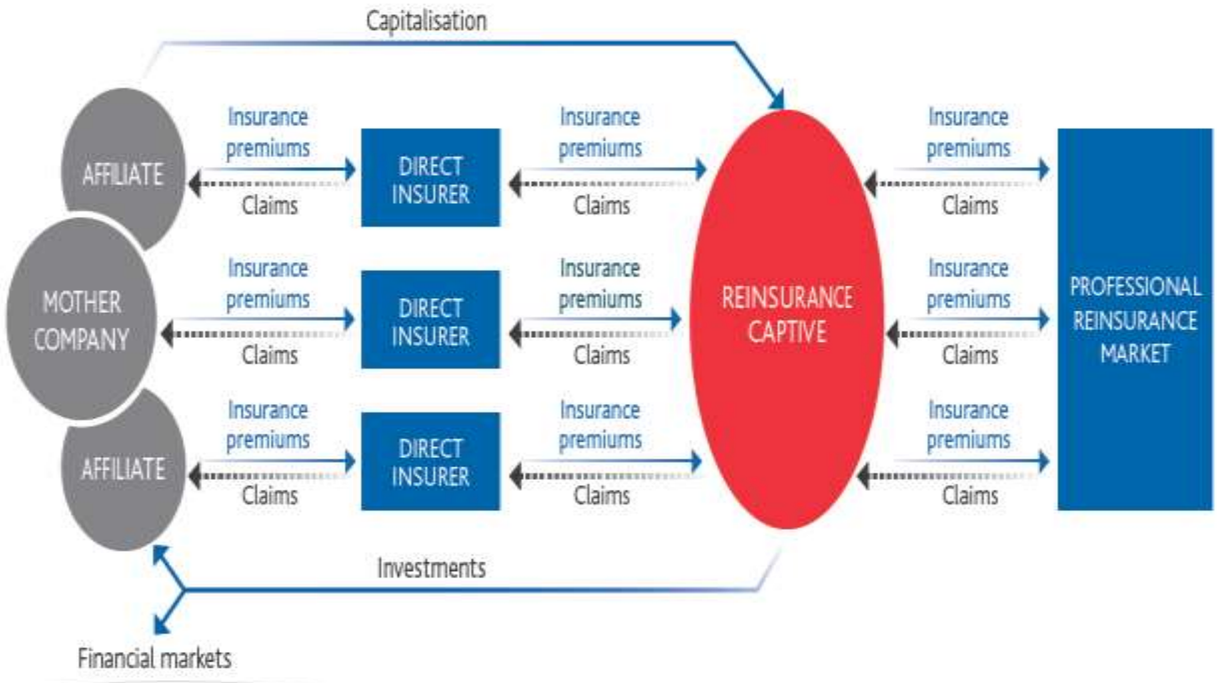
FIGURE 15 FUNCTIONING OF A TYPICAL CAPTIVE REINSURANCE SITUATION



Source: WRMA Publication

Annexure XVII: Sample Term-sheet for maize

Crop	Maize			
Location	KAFUE			
WATER DEFICIT INDEX				
Index	Total Amount of Rainfall less than Strike			
Date From	01-Dec	21-Dec	11-Jan	01-Feb
Date to	20-Dec	10-Jan	31-Jan	20-Feb
Strike_1 in mm	20	30	50	50
Strike_2 in mm	10	10	20	20
Notional (kwacha / mm)	1000	1000	1000	1000
Notional (kwacha / mm)	4000	4000	4000	4000
WATER DEFICIT INDEX				
Index	Total Amount of Rainfall less than Strike			
Date From	21-Feb	11-Mar		
Date to	10-Mar	31-Mar		
Strike_1	50	30		
Strike_2	20	10		
Notional (kwacha. / mm)	1000	1000		
Notional (kwacha. / mm)	4000	4000		
Max Index Payout	500000			
WATER DEFICIT INDEX				
Index	Total Amount of Rainfall less than Strike			
Date From	01-Dec			
Date to	31-Mar			
Strike_1	400			
Strike_2	375			
Strike_3	350			
Notional (kwacha / mm	2500			
Notional (kwacha / mm	6000			
Notional (kwacha/ mm	11500			
Max Index Payout	500000			
Total Sum Insured (kwacha/ha)	**750000**			
Premium kwacha./ha	**75000**			

Annexure XVIII: Survey/ FGD Questionnaire

A. Household Survey Questionnaire

Explain to the individual:

Hello, my name is ________. I am interviewing people on behalf of MicroEnsure. We would like to find out about your family, your farming activities and how you might deal with a threat to your crops such as a drought or flood.

The interview will take about 30 minutes and your answers are strictly confidential. Just let me know you are uncomfortable answering any of the questions and we will move onto the next one.

QUALIFYING QUESTION

Q.0.1 – DO YOU OR ANYONE IN THIS HOUSEHOLD OWN OR CULTIVATE ANY PLOTS?		
I am a farmer	Enter number of hectares farmed: __________	Go to Q.1.1
I work as a farm labourer	YES / NO	If no, end interview, with thanks
I do not engage in farming activities		End interview, with thanks

1. RESPONDENT DETAILS AND DEMOGRAPHICS

Q.1.1 - NAME OF RESPONDENT		
Q.1.2 - ADDRESS OF RESPONDENT	Q.1.2.1 - DISTRICT NAME	
	Q.1.2.2 - CHIEFDOM NAME	
	Q.1.2.3 - VILLAGE NAME	
Q.1.3 - WHAT IS YOUR AGE? (YEARS)		
Q.1.4 - SEX (NOTE, DO NOT ASK)		M / F (Circle as appropriate)
Q.1.5 - WHAT IS YOUR MOBILE PHONE NUMBER?		
Q.1.6 - WHAT IS YOUR MAIN OCCUPATION? (SINGLE ANSWER)		
Q.1.7 - HOW MANY PEOPLE LIVE IN YOUR HOUSE AND EAT FROM THE SAME POT WITH YOU?		

2. EDUCATION AND HEALTHCARE

Q.2.1 - WHAT IS YOUR HIGHEST LEVEL OF EDUCATION? (SINGLE ANSWER, CIRCLE AS APPROPRIATE)	No Formal Education	Primary	Secondary	College	University
Q.2.2 - HOW MANY VISITS HAVE YOU OR YOUR FAMILY MADE TO A HEALTH CLINIC OR HOSPITAL IN THE PAST YEAR? (ENTER FOR GOVERNMENT AND PRIVATE PROVIDERS)	Government or Mission Provider			Private Provider	
Q.2.3 - HOW MUCH DID IT COST? (TOTAL FOR ALL VISITS)					
Q.2.4 - HOW DID YOU PAY FOR HEALTHCARE EXPENSES? (SINGLE ANSWER)					

3. CROP & LIVESTOCK DISASTER PROFILE

SINGLE ANSWER			
Q.3.1 - WHAT IS THE WORST DISASTER THAT HAS AFFECTED YOUR LIVESTOCK IN THE PAST 20 YEARS?			
CAUSE	LIVESTOCK TYPE	NUMBER OF LIVESTOCK LOST	YEAR

SINGLE ANSWER	
Q.3.2 - WHAT IS THE WORST DISASTER THAT HAS AFFECTED YOUR CROP? (Circle One Only)	
Excess Rain	Hailstorm
Flood	Pest Attack
Low Rain	Windstorm
Drought	
Other:	

Q.3.3 - IN WHAT YEAR DID THE DISASTER OCCUR?
Enter Year: ____________________

Q.3.4 - HAVE YOUR PLANTING DATES BECOME MORE OR LESS VARIABLE SINCE THE YEAR 2000?
More Variable / Less Variable

Notes:

Q.3.2 - Worst is defined as the event that caused the greatest loss in yield.

Q.3.2 - Disaster should have occurred in the past 20 years.

4.1 ASSETS - CROP INFORMATION

Q.4.1 - WHAT CROPS DID YOU GROW FOR THE LAST GROWING SEASON?					
CROP	AREA CULTIVATED (HECTARES)	IS THIS CROP GROWN FOR A CONTRACT FARMING SCHEME?	CROP	AREA CULTIVATED (HECTARES)	IS THIS CROP GROWN FOR A CONTRACT FARMING SCHEME?
Bambara Nuts		YES / NO	Sorghum		YES / NO
Cassava		YES / NO	Soya		YES / NO
Coffee		YES / NO	Sugarcane		YES / NO
Cotton		YES / NO	Sweet Potatoes		YES / NO
Groundnuts		YES / NO	Sunflower		YES / NO
Maize		YES / NO	Tobacco		YES / NO
Millet		YES / NO	Vegetables		YES / NO
Paprika		YES / NO	Other:		YES / NO
Peagon Peas		YES / NO			
Pulses		YES / NO	Other:		YES / NO
Rice		YES / NO			

4.2 ASSETS – CROP INFORMATION

Q.4.2 - DETAILED CROP INFORMATION (NOTE, COMPLETE FOR TWO CROPS WITH LARGEST AREAS CULTIVATED FROM Q.4.1)		
	Crop 1: ____________________	Crop 2: ____________________
How did you obtain your inputs?		
What was your total yield? (kg)		
(Planned / Formal) How many kilos did you sell to government / commercial buyers? (kg)		
(Unplanned / Informal) How many kilos did you sell? (kg)		
Why did you sell your produce?		
Why did you not sell your produce?		

4.3 ASSETS – LIVESTOCK

MULTIPLE RESPONSE				
Q.4.3 – WHAT LIVESTOCK DOES YOUR HOUSEHOLD OWN?				
LIVESTOCK	QUANTITY OWNED	EXPECTED MARKET VALUE PER ANIMAL (MWK)	HOW MANY HAVE YOU SOLD IN THE PAST 12 MONTHS?	WHY DID YOU SELL?
Dairy Cattle				
Beef Cattle				
Draft Cattle				
Goats				
Pigs				
Sheep				
Donkeys				
Chickens				
Rabbits				
Ducks				
Other:				
Other:				

4.4 ASSETS - FARM TOOLS

MULTIPLE RESPONSE	
Q.4.4 - WHAT FARM TOOLS DOES YOUR HOUSEHOLD OWN? (Enter quantity in RH column)	
Tractor	
Petrol-Powered Plough	
Ox Plough	
Ox Reaper	
Ox Cart	
Ox Cultivator	
Hand Tools	
Other:	

4.5 ASSETS - IRRIGATION

SINGLE RESPONSE
Q.4.5 - HOW MANY HECTARES DID YOU IRRIGATE LAST SEASON?
Enter number of hectares irrigated: ________________

4.6 ASSETS - LAND OWNERSHIP

SINGLE RESPONSE
Q.4.6 - DO YOU HAVE A TITLE TO THE LAND THAT YOU FARM?
YES / NO (Circle as appropriate)

5. ASSET MANAGEMENT

Q.5 - WHO MAKES DECISIONS REGARDING THE FOLLOWING: (Circle as appropriate)	
Q.5.1 - What to grow (e.g. Maize / Cash Crops)	M / F / BOTH
Q.5.2 - Purchasing seeds	M / F / BOTH
Q.5.3 - Purchasing fertilizer	M / F / BOTH
Q.5.4 - Purchasing pesticides	M / F / BOTH
Q.5.5 - When to plant	M / F / BOTH
Q.5.6 - When to apply fertilizer	M / F / BOTH
Q.5.7 - When to apply pesticides	M / F / BOTH
Q.5.8 - When to harvest	M / F / BOTH
Q.5.9 - Selling the harvested crops	M / F / BOTH
Q.5.10 - Purchasing livestock	M / F / BOTH
Q.5.11 - Selling livestock	M / F / BOTH
Q.5.12 - Purchasing farm tools	M / F / BOTH
Q.5.13 - Sending your children to school	M / F / BOTH
Q.5.14 - Borrowing money	M / F / BOTH
Q.5.15 - Other household financial decisions	M / F / BOTH

6. INCOME ASSESSMENT

MULTIPLE ANSWER
Q.6.1 - DO YOU HAVE ANY OTHER SOURCES OF INCOME? (Circle as appropriate)
Casual Labour
Selling Charcoal
Remittances (e.g. Financial gifts from family / friends)
Other:

7. FINANCIAL SERVICES ASSESSMENT

Q.7.1 - HAVE YOU OBTAINED A LOAN IN THE PAST YEAR	YES / NO (Circle as appropriate, If no, go to question 7.6)
Q.7.2 - WHAT DID YOU USE THE LOAN FOR?	
Q.7.3 - WHAT WAS THE TOTAL LOAN AMOUNT? (MWK)	
Q.7.4 - WAS THE LOAN FORMAL? (E.G. FROM A BANK / MFI)	YES / NO (Circle as appropriate)
Q.7.5 - WHAT SECURITY (IF ANY) DID YOU GIVE TO OBTAIN YOUR LOAN?	

Q.7.6 - DO YOU HAVE A BANK ACCOUNT?	YES / NO (Circle as appropriate)									
Q.7.7 - HAVE YOU EVER PURCHASED AN INSURANCE PRODUCT?	YES / NO (Circle as appropriate)									
Q.7.8 - IS INSURANCE A GOOD THING? (Circle one only or tick unsure) (1 = INSURANCE IS BAD, 10 = INSURANCE IS GREAT)	1	2	3	4	5	6	7	8	9	10
	☐ I am unsure what insurance is									

8. RISK MANAGEMENT

MULTIPLE RESPONSE	
Q.8.1 - WHAT WOULD YOU DO IF YOUR CROP WAS DAMAGED?	
Work as a labourer	YES / NO (Circle as appropriate)
Sell livestock	YES / NO (Circle as appropriate)
Sell charcoal	YES / NO (Circle as appropriate)
Borrow money	YES / NO (Circle as appropriate)
Rely on government / donor handouts	YES / NO (Circle as appropriate)
Other:	

9. NUTRITION

SINGLE RESPONSE	
Q.9.1 - HOW MANY MEALS DO YOU EAT PER DAY?	Enter number of meals: _______________
Q.9.2 - HOW MANY WEEKS PER YEAR DO YOU EXPERIENCE FOOD SHORTAGES?	Enter number of weeks: _______________
Q.9.3 - HOW MANY MEALS DO YOU EAT PER DAY DURING FOOD SHORTAGES?	Enter number of meals: _______________

10. LIVELIHOOD DEVELOPMENT

MULTIPLE RESPONSE	
Q.10.1 - WHAT WOULD YOU DO TO IMPROVE YOUR LIVELIHOOD?	
Buy better quality farm inputs (e.g. Seed, fertilizer, pesticides)	☐ (Tick if applicable)
Buy more farm tools (e.g. Tractor)	☐ (Tick if applicable)
Buy / farm more farm land	☐ (Tick if applicable)
Move to the city	☐ (Tick if applicable)
Move to another location	☐ (Tick if applicable)
Start a new business	☐ (Tick if applicable)
Other:	

B. Focus Group Discussion Questionnaire

Focus Group Discussion

Date of FGD	
District Name	
Chiefdom Name	
Village Name	
Cooperative / Group Name (If Any)	
Number of Male Participants	
Number of Female Participants	
Contact Person	
Contact Number	
FGD Led By	
Duration of FGD (hh:mm)	

Focus Group Outline Structure

1. How many of the group are farmers?

2. How many of the group work as day labourers?

3. How many of the group have a title to the land that they farm?

4. What was the single catastrophic event that affected the farming activities of everyone in the group?
   Notes: A catastrophic event is one that the group agrees affected everyone in a similar way. Any time period is acceptable.

5. What was the single weather-related catastrophic event that affected the farming activities of everyone in the group since the year 2000?
   Notes: This must be an event that WII can cover (e.g. low / excess rainfall, drought / flood, frost damage).

6. What was the short-term response to Q5?
   Notes: Short-term is defined as the three-month period after the event. Note which family members were affected by each coping mechanism.

7. What was the long-term response to Q5?
   Notes: Long-term is defined as the consequences that remained for longer thar three months following the event. Note which family members were affected by each coping mechanism.

8. What precautions do you take against the weather-related risks?
   Notes: Assist the group to talk about both portfolio choice (e.g. using livestock as savings, planting both food and cash crops) and crop management (e.g. staggered sowing dates, use of hybrid seed and irrigation)

9. How many of the group have heard of insurance?

10. How many of the group have ever purchased an insurance product?

11. How many of the group have ever purchased an insurance product to protect their farming activities?

Go through Weather Index Insurance information sheet with the group. Outline the problems associated with traditional insurance products and the benefits associated with Weather Index Insurance.

Use examples (such as 'how many chickens' and 'how many beers' to insure one acre of land) to gauge an understanding of willingness to pay.

Further questions:

12. What is maximum distance a weather station should be from your farm? (e.g. 20km, 15km, 10km)

13. What do you think you could do to raise your income / yield output from your farming activities?

14. How long do you think it would take to reach this goal?

Annexure XIX: Detail of FGD Locations and participation

District Name	Number of FGDs	Village Name	Number of Male Participants	Number of Female Participants	Total Participants
Chibombo	3	Chitanda	10	4	14
		Chamuka	8	2	10
		Muyamba	0	10	10
Mongu	3	Royal Village	10	3	13
		Sefula Rural Development project	0	8	8
		Liyoyela	3	6	9
Kafue	4	Shakulya	15	29	44
		Mwachingwala	0	17	17
		Manachili	11	5	16
		Kanyangala	35	32	67
Masaiti	2	Saka	70	85	155
		Mapota	17	5	22
Total No. of Participants			**179**	**206**	**385**

Summary of the FGDs:

Details	Total for all FGDs
Male Participants (% of Group)	45%
Female Participants (% of Group)	55%
Farmers (% of Group)	100%
Day Labourers (% of Group)	8%
Land Title (% of Group)	3%
Heard of Insurance (% of Group)	76%
Purchased Insurance (% of Group)	6%
Purchased Agricultural Insurance (% of Group)	1%

Detail	Total for all FGDs
Total Male Participants	179
Total Female Participants	206
Total Participants	385

Annexure XX: Investment plan

A. Investment plan BAROTSE

Barotse				year 1	year 2	year 3	year 4	year 5	year 6	year 7
Total cultivated land in ha	5%	684000	ha							
Premium per ha (@ 8% of the sum insured)		16								
- Sum insured for maize, cassava	100%	200	$							
- cash crops	0%	1000	$							
% of cultivated land likely to be covered under WBCIS				3%	4%	5%	4.50%	5.50%	6%	6%
Insurance profit margin		20%								
Insurance profit per ha		@3.2	$/ha	54720	76608	98496	98496	120384	131328	131328
Profit from mobile subscriptions per ha per season(in $)		0.5	$/ha	8550	11970	15390	15390	18810	20520	20520
Total capex and stations required (in $ mn)		0.33		110423	110423	110423				
Total maintenance cost on stations (in $ mn)		0.08		26093	52186	78279	78279	78279	78279	78279
Net cash (in $)				**-73246**	**-74031**	**-74816**	**35607**	**60915**	**73569**	**73569**
Expected breakeven period		7	years							

B. Investment plan KAFUE

Kafue		Details	Unit	year 1	year 2	year 3	year 4	year 5	year 6	year 7
Total cultivated land in ha	4.5%	742500	ha							
Premium per ha (@ 8% of the sum insured)		28.8								
- Sum insured for maize	80%	200	$							
- cash crops	20%	1000	$							
% of cultivated land likely to be covered under WBCIS				3%	4%	5%	4.50%	5.50%	6%	6%
Insurance profit margin		20%								
Insurance profit per ha		5.76	$/ha	106920	149688	192456	192456	235224	256608	256608
Profit from mobile subscriptions per ha per season(in $)		0.50	$	9281	12994	16706	16706	20419	22275	22275
Total capex on stations required (in $ mn)		0.69		229471	229471	229471				
Total maintenance cost on station (in $ mn)		0.16		54224	108448	162672	162672	162672	162672	162672
Net cash ($)				**-167494**	**-175238**	**-182981**	**46490**	**92971**	**116211**	**116211**
Expected breakeven period		7	years							

C. Capital Expenses

Capital Items	Details	Based on seasonal rainfall	Based on March Rainfall
Installation of AWS			
- No. of AWS Installed in Barotse		106	225
- Degree of accuracy required in %	5		
- No. of AWS Installed in Kafue		159	530
- Degree of accuracy required in %	5		
Server to receive data with backup power (in $ mn)		0.02	
Conveyance (Second Hand Motor Cycles @ $ 2000 each, 2 per project zone)		0.01	
Total Capital expenditure required (in $ mn) in Barotse		0.21	0.45
Total Capital expenditure required (in $ mn) in Kafue		0.32	1.06

D. Station Maintenance Expenses

Station Maintenance Expenses per station (in USD)	472.6
Communication charges per annum	30
4 maintenance trips per annum	
- Each round trip of 50 km fuel charge of $ 1.65 per litre, Mileage 50 km per litre	6.6
Depreciation of conveyance per annum	32
Salary of technical staff (2 people @ $ 400 per month each)	384
Bike maintenance	20