changing farming for
a changing climate

Comparative Assessment of Selected Agricultural Weather Index Insurance Strategies in Sub-Saharan Africa

Research Report commissioned by Vuna | July 2016

Adam Smith International

UKaid from the British people

Please cite this publication as follows:

Arce, Carlos. 2016. Comparative Assessment of Selected Agricultural Weather Index Insurance Strategies in Sub-Saharan Africa. Vuna Research Report. Pretoria: Vuna. Online: http://www.vuna-africa.com

Project Team

Project Team Leader	David Rohrbach
Project Manager	Vimbai Chasi
Editor	Mark Essig

Date: July 2016 | **Lead Author:** Carlos E. Arce | **QA'd by:** John Cantrill, Vimbai Chasi, Mark Essig & David Rohrbach

Vuna is a DFID-funded regional Climate Smart Agriculture Programme. The British Government's Department for International Development (DFID) financed this work as part of the United Kingdom's aid programme. However, the views and recommendations contained in this report are those of the consultant, and DFID is not responsible for, or bound by the recommendations made.

UKaid from the British people

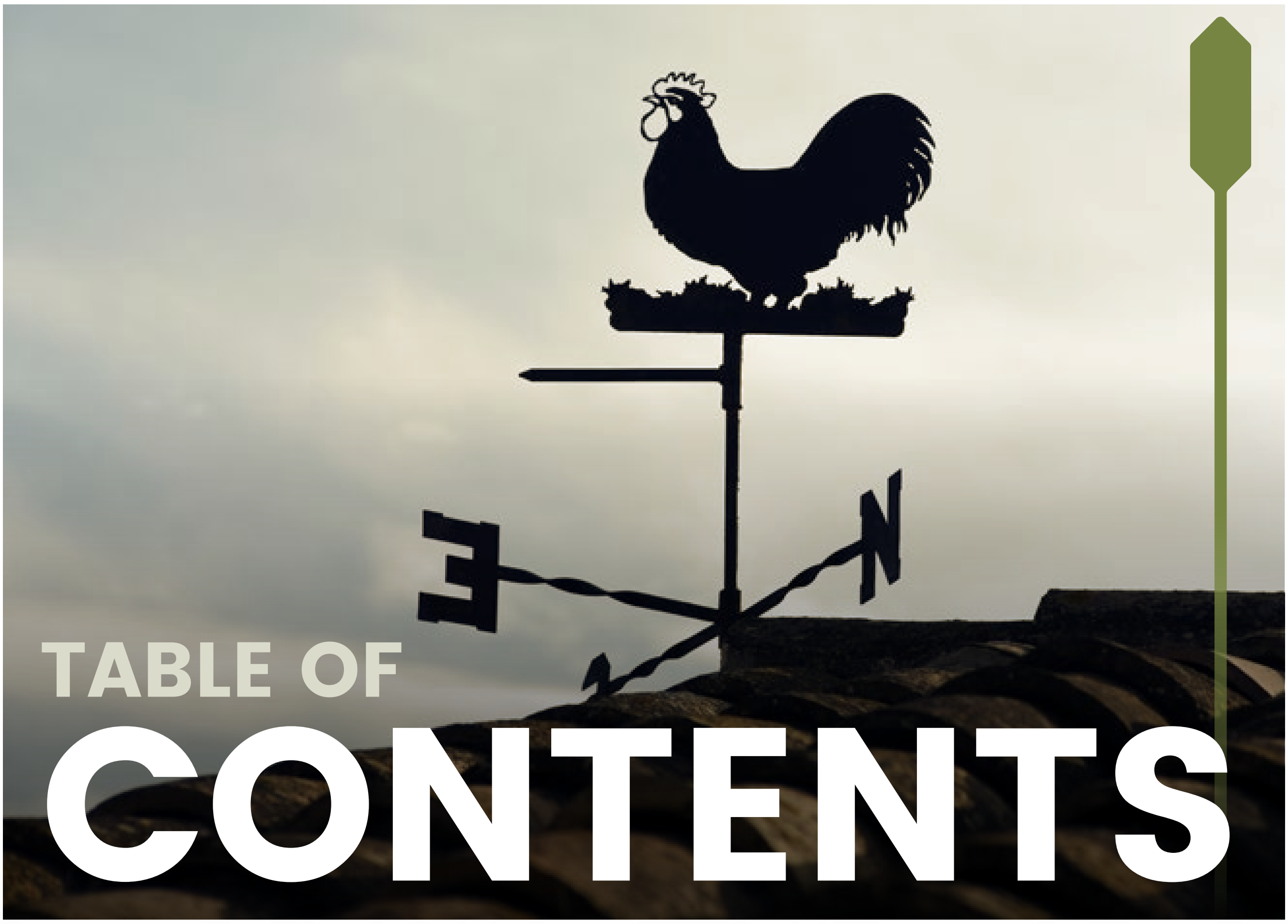


TABLE OF CONTENTS

List of Tables

Acronyms

ACRE	Agriculture and Climate Risk Enterprise
AGMARK	Agricultural Market Development Trust
ARC	African Risk Capacity
ARC	African Risk Capacity
CSA	Climate Smart Agriculture
CSAP	Climate Smart Agriculture Programme
CSR	Corporate social responsibility
DFID	Department for International Development
FAO	Food and Agriculture Organization of the United Nations
FSD	Financial Sector Deepening
GIFF	Global Index Insurance Facility
GSMA	Groupe Speciale Mobile
IBCI	Index-based Crop Insurance
IBLI	Index-based Livestock Insurance
IFC	International Finance Corporation
ILRI	International Livestock Research Institute
MOA	Ministry of Agriculture
NDVI	Normalised Difference Vegetation Index
NGO	Non-governmental organisation
NWK	Zambian agricultural services provider
R&D	Research and Development
USAID	United States Agency for International Development
WBCIS	Weather Based Crop Insurance Scheme
WII	Weather Index Insurance

Executive Summary

This paper presents a review of the commercial sustainability, profitability, challenges, impact, and potential contribution of weather index insurance (WII) products to improving resilience in weather-affected agricultural systems in developing countries. This is important given the continuing demand on governments to manage the considerable weather risk faced by smallholders in Sub-Saharan Africa and other weather-exposed regions in developing economies.

This assessment has been developed in a two-step process. First, a literature review was conducted summarising the global experience in developing weather index insurance programmes. Second, we conducted a field investigation designed to extract a more detailed understanding of whether the results of recently launched WII pilots in Sub-Saharan Africa (in Kenya, Tanzania, Zambia, and Zimbabwe) are in line with the global experience.

The introduction of WII was triggered by the shortcomings demonstrated by traditional agricultural insurance, which bases indemnity payments on verifiable losses. Two key problems of such traditional policies are the potential for fraud and the high operational costs of issuing contracts to large numbers of dispersed smallholders in remote rural areas. There seems to be a consensus that traditional insurance products simply do not work in such circumstances.

The findings of this assessment identify no examples of the commercially sustainable application of WII in support of smallholder farmers. Donor-supported experimentation with an evolving set of methods continues. Some programmes have been sustained with substantial subsidies. However, the prospects for finding a commercially sustainable solution are low.

In particular:

The experience of agriculture WII projects to protect smallholders in developing countries shows a high rate of pilot failures, low uptake, and little evidence of commercial sustainability. The findings show very low uptake by farmers in developing countries, and less than a handful of the many pilots tested are still operational.

The performance outcomes of the pilot projects do not motivate insurers to consider WII as a profitable line of business. None of the insurance companies in Sub-Saharan Africa consider WII a profitable line of business. The industry has experienced high loss ratios that do not allow them to cover even their operational and administrative costs. A few pilots have shown growth, thanks primarily to substantial funding provided by donors for insurance platforms, technical expertise, data processing, contract design, educational and awareness programmes, marketing, and contract monitoring. There is no indication that insurers will invest in independently developing the WII market. Most would consider this product only as part of their corporate social responsibility policies.

There are no clear signs that WII represents a value proposition to poor farmers, who show a very low appreciation and demand for the product even when it is offered for free. Despite pilot testing of many types of weather index insurance products in low-income countries for over a decade, its uptake has been far below expectations. Index insurance has been widely accepted only in a few cases where it was either free or heavily subsidised. In some of those cases, farmers who received subsidised insurance tended to undertake riskier agricultural activities than those uninsured.

> “The main lingering question is whether a subsidised product can offer a cost-effective safety net in risky environments.

A long list of development problems has not been solved. These include technical barriers (especially with the availability and reliability of data, and the accuracy of indexes), a lack of demand among farmers, a lack of logistical support, and lack of profitability of the products. And because insurers do not regard WII as a profitable line of business, they have shown little interest in investing in market development.

There are no clear signs that WII has potential to become a commercially sustainable solution for poor smallholders to manage weather risks. Based on the findings of this assessment, the overall conclusion is that WII products for smallholder farmers do not show the potential to become a practical product that can be widely and reliably used as part of a strategy to effectively manage weather risk. Such products are unlikely to make a meaningful contribution to strengthening the resilience of smallholders in Sub-Saharan Africa. The main lingering question is whether a subsidised product can offer a cost-effective safety net in risky environments.

1 Introduction

Agricultural production and trade are becoming riskier as a result of the higher temperatures and more variable rainfall associated with climate change. These risks raise the costs of agricultural lending and reduce the opportunity and incentives of farmers to invest in new technologies, including climate smart technologies that may improve the resilience of local farming systems. Correspondingly, traders and agro-processors face lower incentives to invest in building value chains into drier, or riskier, agro-ecologies.

Traditional agricultural insurance appears to be ill-suited to meet these challenges. Many analysts have concluded that such traditional insurance, which bases indemnity payments on verifiable losses, simply does not work for smallholder farmers in developing countries. The first shortcoming of this traditional model is the potential for fraud, because it is extremely difficult to monitor many small plots against false declarations. Second, in many situations only farmers with high risks buy insurance, raising costs for insurers. Finally, traditional insurance encounters high transaction costs selling contracts to large numbers of dispersed smallholders in remote rural areas.

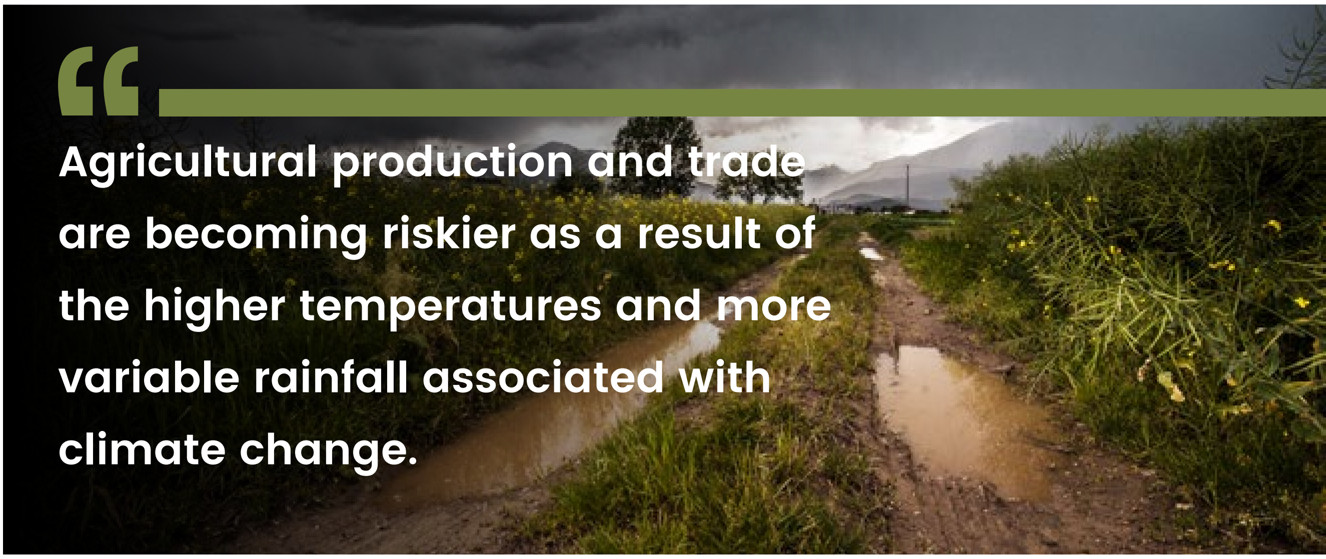
WII was created to address these problems and to offset these agricultural investment risks. The index is designed to serve as a proxy for crop growth and harvest yield. Early efforts involved building indexes from a combination of rainfall data and crop modelling. When these models proved inadequate, a normalised difference vegetation index (NDVI), calculated through remote sensing, was applied. In theory, the model can predict, for instance, how many tonnes per hectare of a crop are lost for every millimetre of rainfall excess or deficit in a specific location. WII promises to overcome the shortcomings of traditional agricultural insurance because it relies on measurable, objective standards. Just as important, the elimination of field loss assessments would drastically reduce administrative costs.

But this strategy still needs to be linked to an understanding of crop growth and harvest parameters. There remains an essential, and potentially costly, need for ground-truthing. Are the indexes now being applied accurate enough to provide a reliable measure of losses and justification for payouts? Is the combination of indices and ground-truthing cost effective for the commercial insurance industry?

This report examines the potential for WII products to improve resilience in agricultural systems in developing countries. It involves two stages, a literature review and a field investigation.

The literature review summarises the global experience in developing weather index insurance programmes, focussing on their commercial sustainability, profitability, challenges, and measurable impacts. The review indicates that for over a decade donors and governments in developing countries have invested heavily in testing various forms of WII. After experimental piloting of WII in over 15 countries, results indicate a very low uptake among farmers and a lack of profitability for insurers. These results are summarised in section 2.

The field investigation examines whether recently launched WII pilots in Sub-Saharan Africa have overcome the shortcomings of the international experience. Those findings are detailed in section 3. Section 4 summarises the assessment and offers some concluding remarks.



2 Global experience

Since 2005, more than $40 million has been committed to WII programmes in developing nations, including at least eight countries in Eastern and Southern Africa. USAID has funded several programmes that have been implemented by US agricultural universities.[1] A larger share of the funding for experimental programmes in Africa has been committed through the World Bank.[2]

A review of these programs raises a number of important questions. Is WII fulfilling its goal of helping smallholder farmers manage risk? Do the farmers see a value proposition in acquiring the insurance? Are technical constraints to providing a cost-effective product being resolved? Is WII becoming commercially profitable? Are there any signs that commercial insurance companies will expand investments in WII on their own?

The review notes that public subsidies have offset a significant share of the costs of product development, promotion, and supervision in all of the pilot projects. In many of those still operational, subsidies still cover parts of the costs of premiums. This raises the question of whether WII can offer a cost-effective safety net offsetting farming risks in risky environments.

2.1 Background

Farmers face a wide variety of risks (see Table 1) and have developed a variety of strategies for managing them. Risk during the production cycle generally arises from weather and biological factors such as disease and pests. Such production risks can be managed by a combination of strategies. First, mitigation measures (such as good agricultural practices, irrigation, and drainage) lower the losses when risks are realised. Second, risk transfer instruments (i.e., insurance) shift all or some of the risk to a third party in exchange for a fee. Finally, coping strategies (such as selling assets, reducing consumption, migrating, or accepting government assistance) reduce the impact of those realised risks that could not be mitigated or transferred. In practice, farmers tend to rely on all of these strategies. The particular combination chosen depends on the country's risk profiles, levels of institutional and market development, and fiscal constraints.

Table 1: Key risks faced by farmers

Risk	Examples/factors	Effects
Weather risks	Rainfall, temperature, hail, wind	Lower yields, loss of productive assets or income
Biological risks	Pests, disease, contamination	Lower yields, loss of income
Price risks	Low prices, market supply and demand, volatility	Lower prices, loss of income
Labour and health risks	Illness, death, injury	Loss of productivity, loss of income, increased costs
Policy and political risks	Regulatory changes; political upheaval; disruption of markets; unrest	Changes in costs, taxes, market access

Traditional weather insurance products, mostly sold in developed countries, aim at covering a wide range of production risk. Such products include named peril crop insurance (NPCI), in which the insurance claim is calculated by measuring the percentage of damage resulting from a particular, named weather loss in the field, soon after the damage occurs; and multiple peril crop insurance (MPCI), in which multiple sources of loss (e.g., hail, drought, floods) may be considered. Both sorts of policy tend to be yield-based. Typically, an insured yield (tonnes per hectare) is calculated as a percentage (typically 50%-70%) of the historical average yield of the farmer. If the realised yield is less than the insured yield, the insurance company pays an indemnity.

1 For example, the Index Insurance Innovation Initiative (I4), which was carried out through at the University of California at Davis, seeks to design, implement, and test a new generation of livelihood-optimised index insurance contracts.

2 European Union, Swiss, and Dutch development cooperation funds have supported the World Bank in its technical assistance, infrastructure development, risk-pooling, and co-financing of WII products. Currently, the largest share of resources is being committed through the World Bank's Global Index Insurance Facility (GIIF).

Though suitable for developed countries, such traditional agricultural insurance products have been difficult to adapt for smallholder farming in developing countries. Reasons for the difficulties include limited commercialization in the countries, small average farm sizes, geographical dispersion of farmers, fraud, adverse selection[3], and high transaction costs.

WII has emerged as an alternative. It was first developed in the international weather derivative market, where major corporations hedge weather risks (e.g., in the energy market). In WII, indemnity payments are not based on the assessed losses of individual policyholders. Instead, payments are linked to an index, which is based on estimates of the weather requirements for the insured crop (or livestock) to develop satisfactorily. These weather requirements are summarised in a model that measures how key weather variables, particularly rainfall (but potentially also temperature, wind speed, and solar radiation) affect crop or pasture growth. The model identifies weather extremes that lead to losses in yield. An indemnity is paid whenever the realised value of the weather index exceeds a specified threshold (e.g., when protecting against excessive rainfall) or falls short of that threshold (when protecting against drought). A WII product can help a farmer transfer weather risks occurring throughout the crop growth cycle (i.e., sowing, vegetative growth, flowering, and harvesting) or during a key part of this cycle (e.g., germination).

The most attractive technical characteristic of the WII product is that it relies on a model that predicts the changes in yields of specific crops (or livestock enterprises) resulting from changes in weather parameters. The insurance industry needs to monitor only key weather parameters near the farmer's crop, not the crop itself. Indemnities can be paid on the basis of remote observations of weather conditions, without having to assess damages in farmers' fields.

This innovation carries the potential to avoid several key shortcomings of traditional agricultural insurance in developing countries. There is no moral hazard[4] and low adverse selection, because the trigger for payouts is based on objective weather observations. Equally important, the elimination of field assessments means that administrative costs can be drastically reduced. These factors increase the possibility that WII may be commercially sustainable.

WII became feasible when FAO developed the water requirement satisfaction index (WRSI), which estimates yields based on rainfall patterns. An early programme in India tested WII's potential for protecting the rural poor. The World Bank then promoted a series of pilot projects intended to provide low-cost, commercially sustainable, individual protection for small farmers in a number of other developing economies (World Bank, 2005). In large part due to World Bank support, more than 15 developing countries introduced experimental WII pilot programmes for individual farmers.

3 After adverse selection is missing and this is the text: 3 Adverse selection is a situation where only farmers at highest risk for loss buy insurance.

4 After moral hazard is missing and this is the text: 4 The term moral hazard describes an incentive to take higher risk because somebody else is bearing the potential costs. For example, a farmer might not adequately manage a crop to limit damages during a drought because the crop is insured.

2.2 Levels and types

WII products have been designed at two levels: micro (or farmer-based) and macro (or regionally or nationally based). This paper principally reviews only micro insurance programmes.

Micro level. The policyholder is typically an individual farmer, and the policy is designed to protect against one or more risks:

- ***Yield protection.*** These contracts are designed to offer broad protection against drops in yields caused by weather for the duration of the crop cycle, from sowing to harvest. The index triggers payments if the farm encounters abnormal weather during specified phases of the crop cycle (i.e., sowing, growth, flowering, harvest). The index can trigger cumulative yield losses for each phase. Generally, a single payment is made at the end of the contract. In effect, this policy protects the value of the harvest.
- ***Inputs credit protectio*n.** This product is designed to protect only the value of a loan for inputs (such as seeds and fertilizer) against weather risk, from sowing to harvest. The credit provider pays the premiums at the beginning of the season, and the amount is typically added to the value of the loan. The policy aims both to protect the credit provider from default due to weather risk and to maintain the credit worthiness of farmers. Any pay-outs are made to the credit provider to cover the value of the inputs loan.
- ***Seed protection*.** This product covers only the loss of seed caused by rainfall deficits during the period of germination. Typically, the contract is valid for the 21 days of the sowing window. The goal is to allow the farmer to purchase replacement seed and replant during the same season.
- ***Social protection*.** This product provides generic protection to vulnerable households in the event of production losses caused by weather. Payments are triggered by severe regional weather events regardless of what happens in an individual farmer's field. Typically, these payments are viewed as a safety net for household food security.

In some cases, the policyholder may be the input supplier or the credit supplier instead of the farmer. This sort of policy may be referred to as a "meso level" WII. The characteristics of these policies are similar to those of the micro level. A bank may pay for the input credit protection to directly offset this liability. A seed company may offer farmers seed insurance as a means to encourage purchases of its varieties. In these cases, indemnity payments are made to the company, not to farmers. In fact, farmers may not even know their inputs are insured.

Macro level. The policyholder is the government, whether at the federal, national, or municipal level. This macro application generally is meant to assist the government by quickly providing short-term liquidity following catastrophic events. These finds can help finance the costs of drought or flood relief programmes.

The best known pilot applications of WII for Sub-Saharan Africa are summarised in Table 2. This table shows a wide array of pilot tests at two levels (micro and macro) and several types (social protection, input credit protection, yield protection, and seed protection). The structure of these pilots has evolved over time. For example, early pilots were commonly based on weather data from individual weather stations. More recently, WII models have sought to reduce costs by using satellite observations and NDVI.

Table 2: Recent weather index insurance pilots in Sub-Saharan Africa by level and type

Level	Type	Recent pilots *(examples in Sub-Saharan Africa)*
Micro Policyholders are individuals	**Type: Social protection** Protection of smallholders against droughts, conceived as social protection for vulnerable households. Subsidised premium payments with modality of "work for insurance." Satellite-sourced rainfall indexes.	Ethiopia and Senegal: R4, formerly HARITA (OXFAM project). Status: Ongoing
	Type: Input credit protection To protect the value of credit to maize and groundnut smallholders against rainfall risk for the duration of the crop cycle. Weather station observations.	Malawi: Opportunity International Status: Failed
	Type: Input credit protection To protect the value of inputs of cotton farmers against weather risk for the duration of the crop cycle. Ginneries paid premiums at the beginning of the season and recovered the costs from farmers when they delivered the seed cotton. NDVI observations.	Tanzania: Cotton Board / MicroEnsure Status: Failed
	Type: Input credit protection To protect the value of inputs of cotton farmers against weather risk. Premiums paid by the Mozambique Cotton Institute (IAM) for the first year. Evapotranspiration index from satellite observations.	Mozambique: Mozambique Cotton Institute (IAM) / Guy Carpenter Status: Failed
	Type: Input credit protection To protect the value of inputs of cotton farmers against drought. Premiums paid upfront by the agro dealer, who recovers the amount at harvest together with the credit issued.	Zambia: NWK / Musika Status: Ongoing
	Type: Yield protection To protect individual herders against losses caused by drought-induced stress on livestock. Partly subsidised premiums. NDVI observations.	Kenya: ILRI / Ministry of Agriculture Status: Ongoing
	Type: Seed protection Designed to protect farmers against weather risk during sowing window (21 days). It covers the value of purchased seeds. Use of mobile banking for registering, paying premiums, and receive payments. Use of satellite observations.	Zimbabwe: Econet / Seed Co Status: Failed
	Type: Seed protection Designed to protect the value of seed against weather risk during sowing window (21 days), to allow farmers to replant in the same season in case of germination failure. It uses mobile banking for paying premiums and receiving payouts. Satellite-based index.	Kenya, Tanzania, Rwanda: ACRE / Seed Co Status: Ongoing
Macro Policyholders are governments.	**Type: Fiscal risk protection** The main objective of these transfer products is to reduce the fiscal risk of the government when catastrophic events occur. Policies are bought directly from international reinsurers or from special financial vehicles created for this purpose. These reinsurance facilities are usually part of a government's financial strategy for coping with catastrophic risk. Risk events of less intensity are usually covered by the government budget, donor emergency aid, or contingent finance. They are designed also to meet social protection objectives. The Kenyan livestock insurance will cover fiscal risk of the government to protect selected vulnerable pastoralist households against severe droughts. This is designed as part of the government social safety net. For the Malawi sovereign protection, the objective was quick access to a reliable source of contingent financing for drought relief programmes.	• Ethiopia drought index facility for the government (2006). Status: Stopped. • African Risk Capacity (ARC) as a risk pooling among various states and transfer mechanism for food security. Status: Ongoing since 2012. • Kenya Livestock Index Insurance. Status: Ongoing since 2015. • Malawi macro level drought risk protection. Status: Stopped.

2.3 Key Challenges and potential impact

The rest of this chapter will summarise the key challenges facing WII that have been identified through a review of the literature.

2.3.1 Contract design

A complicated set of steps is required in developing a WII contract. These involve the delineation of models that accurately measure how changes in key weather variables affect crop growth, and the identification of how the underlying data needed to run the model should be collected and applied. The various steps undertaken for designing an index contract are summarised in Box 1 below.[5]

Box 1: The steps in contract design

In simplified steps, the insurance company aiming to offer a product for transferring drought risks will do the following:

1. Estimate the probabilities of various levels of rainfall at the location, typically drawing upon historic time series from weather stations close to the farm to be insured.
2. Determine the levels of precipitation that the insured crop needs throughout the crop cycle to grow optimally. This involves adapting a standard crop model containing a WRSI as well as data on evapotranspiration, soil type, and temperature.
3. Based on both sets of data, build a weather index that can predict crop yields for any given level of rainfall. The model should predict how much yield is lost for every millimetre of rainfall deficit or excess of what the crop needs for optimal growth.
4. Compare the weather index with the historical time series of yields (of the crop to be insured at that location) to test the predictive ability of the weather index for that crop in that location. The less correlation between the weather index and the historic time series of yields, the less predictive ability the index will have of future yield losses.
5. Identify the levels of rainfall deficit or excess to trigger payouts at various phases of the crop cycle.
6. Identify the insurance contract parameters including trigger points, minimum payouts, maximum payouts, payouts per millimetre of rainfall deficit or excess, and premium rates.

The process of designing a weather index is data-intensive. To further complicate this effort, the data required for model development are often unreliable or simply unavailable. Donors have funded the hiring of weather experts and modellers, the capturing and cleaning of data on weather and crop yields, and the installation of weather stations. However, such costs are not one-time expenditures. New investments are needed each time the initial contract is adapted to a different region or a new crop is added to the insurance profile. WII contracts cannot be easily replicated across locations or from one crop to another. New crop models and yield data are required for each policy, and these must be tested anew in each environment in order to estimate the model's accuracy and to set policy prices. Experts also must analyse the weather observations on a regular basis to declare potential payouts. This process is costly and slow, in part because there are only a handful of qualified experts globally.

The lack of profitability of WII products prevents insurers from hiring experts to design and monitor contracts. They must instead rely on donor contributions for the entire product development process, including awareness campaigns and marketing.

5 The development of the WII models has consistently been done by technical experts in crop growth who are subsidised by development funds. Some pilot projects have sought to train insurance industry representatives in model development as a step toward assuring the commercial sustainability of the product. However, there are no known cases where insurance companies are independently developing these models.

2.3.2 Basis risk

The biggest single technical challenge facing WII is basis risk—the difference between the level of losses predicted by the model and the actual level of losses experienced by the farmer. The model may predict a larger or smaller loss than the farmer experiences. The model may call for a payment when none is needed. Worse, weather damage may occur to an insured crop, but the model fails to predict this and the insurance contract does not trigger a payment.

Basis risk can be present for a number of reasons, including the following: (i) the crop growth model underlying the weather index is inaccurate; (ii) the data feeding the index model are not reliable, accurate, or complete; (iii) the weather station is not close enough to the farm to accurately measure key weather parameters at that location (e.g., there may be microclimates near the farm, or localised flash floods).

Turvey (2008) and Hazell and Hess (2010) have argued that one solution to basis risk lies in designing contracts only for catastrophic shocks. Although the accuracy of the models or of the underlying data may be limited, they still offer a fair approximation of major losses caused by floods or drought. Correspondingly, some pilots have focused on indexes that trigger payments only for events that occur with high intensity but low frequency.

Questions remain, however, about the level of interest of farmers in catastrophic risk insurance. Many farmers assume that governments and aid agencies will intervene when such extreme losses occur. WII contracts covering only the catastrophic losses might correspondingly be more practical as a component of a government's social protection programme rather than as a policy for protecting individual farmers.

Studies have shown that basis risk depresses the demand for WII products (Dercon et al., 2014). Clarke (2011) similarly argues that index insurance contracts characterised by high basis risk may find low acceptance among highly risk-averse farmers. The insight here is simple but important: when farmers buy insurance, suffer crop losses from a drought, and then receive no payment because the index was not triggered, then they are worse off than if they had not purchased insurance at all. In addition, when basis risk is high, index insurance will fail to serve as an incentive for farmers to invest in additional remunerative but risky technology, a point developed in detail by Carter et al. (2014).

2.3.3 Data

The lack of relevant, reliable, long-term historic data on weather and crop yields continues to be a key technical constraint (Osgood et al*.,* 2007; Kapphan, 2011). Designing a contract with a properly calibrated model requires reliable weather and yield data covering at least 20 years, with no more than 5% of observations missing. In the absence of adequate amounts of data, the pricing of the product must be raised to cover the uncertainty. In some cases, the level of aggregation of yield data is also a problem. Some researchers argue that it is more accurate to include yield data derived from individual farms and farm plots rather than from regional date on average yield. For instance, Laajaj and Carter (2009) (as quoted in Tadesse et al*.,* 2015) find that basis risk could be minimised using a village-level area-yield index derived from plot- and household-level survey data. However, the availability and reliability of such village-level data can also present a challenge.

Weather stations in developing countries are typically located close to airports, dams, and other key infrastructure, and not necessarily in places where smallholders are farming. Investing in establishing a higher density of weather stations has been proposed as a solution. However, the costs of basic weather station infrastructure are substantial, and there are additional ongoing costs of maintenance and administration—something generally beyond the means of national weather services.

Some projects have turned to what is known as "synthetic data": satellite-based observations of weather patterns are combined with detailed data from a smaller number of weather stations to derive estimates of precipitation, rainfall, and other variables for a larger territory. Such information solves the problem of the scarcity of weather data available for pricing and for triggering payouts. It does not, however, solve the issue of basis risk, and in fact is likely to increase it.

NDVI, which is capable of reporting a vegetation index at various resolutions and time intervals, is sometimes used in an attempt to reduce basis risk (Laajaj and Carter, 2009). But though NDVI works in homogenously grown fields, it is difficult to apply it to the multi-crop systems that are typical of small farms in developing countries. Turvey and McLaurin (2012) argue that NDVI should not be widely applied unless calibrated using location-specific data. The same authors also state that more experimentation is required to prove that even such calibrated data can reduce basis risk in smallholder crop systems. NDVI is being applied to estimate livestock conditions in Kenya. However, it has proven difficult to correlate the index with livestock mortality. Model designers continue to experiment with ways to adjust the model in order to better estimate livestock production stress.

2.3.4 Demand

Despite more than a decade of testing many models of WII, the uptake of these insurance policies has been far below expectations (Giné and Yang, 2008; Binswanger-Mkhize, 2012; Cole et al., 2013). The few cases where index insurance has been widely accepted involved situations where the products were either free or heavily subsidised, or where insurance was offered along with other benefits such as subsidised credit and heavy technical assistance. In extensively studied cases in Malawi (Giné, 2009) and India (Cole et al., 2013), uptake was only 20-30% of targeted farmers, with adopters insuring only a very small fraction of their agricultural income.

Low demand for WII has represented one of the most interesting puzzles in development economics over the last decade. Scholars have offered a variety of possible explanations. According to Clarke (2011), the low demand for WII by poor farmers is a rational response to basis risk. For higher uptake, weather index insurance must be cheaper and/or more effective than the current risk management practices of smallholders, such as reliance on social networks and self-insurance mechanisms (e.g., owning saleable assets) (Binswanger-Mkhize, 2012).

Box 2 summarises self-insurance strategies at the individual, community, market, and government levels.

Box 2: Self-insurance strategies

Self-insurance strategies are those that do not rely on a risk-transfer product (insurance). Instead, the farmer undertakes activities aimed at mitigating risks or absorbing shock, either as an individual or as a member of a community. These activities include crop diversification, labour diversification (both on- and off-farm), risk-sharing (a feature of traditional rural communities in which members of the community share the economic risks of unpredictable and cost-intensive events), sharecropping, investing in semi-liquid assets such as livestock, farmer self-help groups, and loans from moneylenders. Markets also create mechanisms to help farm households manage weather risks, including new technology, improved seed varieties and other inputs, formal financial services (including savings and lending), risk-sharing arrangements with input suppliers and wholesalers, and information technology tools.

While many of these strategies can help households cope with the impact of low and moderate weather risks, they are likely to be ineffective in the case of larger weather shocks. Major disasters render household strategies inadequate, primarily because everyone in the area is affected. In such situations, most countries trigger disaster emergency programmes that include infrastructure rehabilitation, handouts, and food aid.

Source: Weather Index Insurance for Agriculture. World Bank (2012)

Mobarak and Rosenzweig (2012) examined, theoretically and empirically, the impact of informal risk sharing on the demand for index insurance, and the effects of index insurance purchase on subsequent risk taking. In theory, informal risk sharing can crowd out demand for index insurance if the network indemnifies rainfall risk, but the authors argue that it could also be a complement to index insurance if the contract carries basis risk. In their randomised field experiments in India, they found substantial support for the hypothesis that higher basis risk leads to lower demand for index insurance, given that farmers have to rely on their self-insurance practices to absorb shocks not covered by the insurance contracts. They argue that the low uptake reflects the low value farmers attach to those policies.

Brans et al. (2010) and Cole et al. (2013), analysing the potential causes of low uptake of WII in the pilot projects, suggest other possible causes that have not yet been addressed: (i) poor farmers cannot afford the high cost of premiums; (ii) farmers do not trust the index and its ability to properly predict the risk of loss; and (iii) lack of credibility on the part of the insurance providers.

2.3.5 Potential Impact

One motivation underlying the promotion of WII has been to increase the opportunity and incentives of farmers to invest in new, potentially riskier technologies, including climate smart technologies that may improve the resilience of local farming systems in the face of climate change.

Researchers have been conducting field experiments under controlled conditions around some of the pilot projects, trying to measure how weather insurance shapes the strategies and behaviours of farmers. The evidence shows there is some degree of correlation between the introduction of subsidised insurance and higher risk taking by insured farmers. McIntosh (2016) summarises the main findings:

- In Andhra Pradesh, farmers who receive insurance were 6% more likely to plant cash crops (Cole et al., 2013).
- In Ghana, farmers increased both fertilizer use and the percentage of land planted to maize (Karlan et al., 2013).
- In China, farmers given tobacco insurance in randomised field experiments increased production of this risky crop by 20% (Cai et al., 2014).

Additionally, Mobarak and Rosenzweig (2012) conducted a randomised experiment in which subsidised rainfall index insurance was offered to Indian farmers. Their results show that insurance helps cultivators reduce self-insurance and switch to riskier, higher-yield production techniques.

Vargas-Hill and Viceisza (2010) used experimental methods to show in a game setting that insurance induced farmers in rural Ethiopia to take greater risks—with the promise of larger profits—by increasing their (theoretical) purchase of fertilizer.

Finally, evidence from India suggests that while insurance provision has little effect on total agricultural investments, it induces farmers to invest more in riskier production activities (Giné et al., 2016). In particular, insured farmers under randomised experiments increased production of castor and groundnut, the main cash crops grown in the study areas. These crops produce higher expected returns but are also more sensitive to deficient rainfall.

2.3.6 Profitability

There is little published evidence on the profitability of WII for participating insurers. However, recent experience in Sub-Saharan Africa, detailed in the next section, shows insurers have experienced high loss ratios[6] and high operational costs. Insurers have taken part in WII projects either as part of their social corporate responsibility initiatives or in an attempt to enter a new field early and capture a large market share in a potential new line of business. But most of the projects have failed, and many insurers have pulled out of the market without making any serious investments in it. This indicates that there is little appetite for WII as a practical or profitable product for insurers.

Additionally, in most countries WII represents an insignificant portion of an insurer's overall portfolio. Most local insurers are retaining no more than 5-10% of the risk in WII products (in some countries such levels are mandated by insurance regulation), leaving most of the business to the reinsurer.[7] This is because agriculture risks are covariate and the liability is very high. When a payout is required, many policyholders are affected and insurers may encounter unexpectedly large losses.

Some insurers in pilot projects in Latin America have also admitted that agricultural insurance carries an additional reputational risk, given the political nature of insuring smallholders with contracts that suffer from unknown basis risk. As the insurers see it, claims from a large number of organised farmers who suffer losses but are not paid because of basis risk could undermine the companies' reputations and damage their market share in more profitable lines of business.

2.3.7 Findings

Overall, the global experience in applying WII to transfer risk of smallholder farmers reveals a picture of low uptake, a high rate of failure in pilot initiatives, and no clear signs of commercial sustainability. Despite the wide array of experimentation and substantial financial support from donors, there has been no self-sustaining commercial scale-up of these programmes. Most of the projects initiated with donor funding have failed. Those still running remain dependent on continuing public subsidies.

Farmer demand for WII has been far lower than anticipated. The few cases where index insurance has been widely accepted involved products that were either free or heavily subsidised. Although experimental findings suggest insured farmers tend to undertake riskier agricultural activities than those uninsured under the same circumstances, the cost effectiveness of this public investment remains questionable.

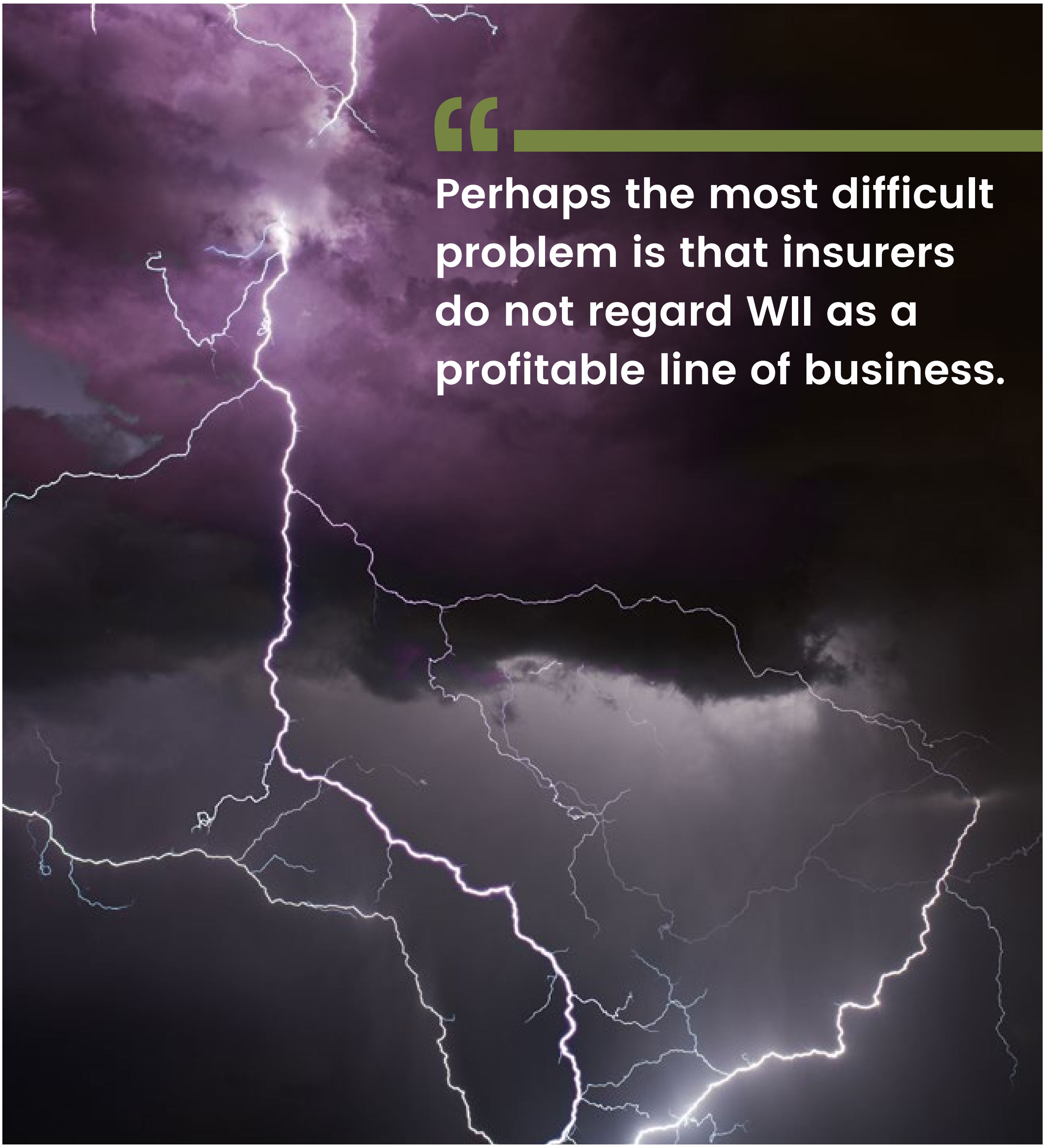
6 The loss ratio is the ratio of total losses incurred (paid and reserved) in claims divided by the total premiums earned. For example, if an insurance company pays $60 in claims for every $100 in collected premiums, then its loss ratio is 60% with a profit ratio/gross margin of 40%, or $40. Some portion of the $40 must pay operating costs, and what is left is the net profit.

7 Most reinsurers are larger international companies based in developed countries. These companies too are testing the market and considering this investment as part of their corporate social responsibility initiatives.

The development and testing of pilot WII programmes continues to require substantial donor funding. This includes public investments in weather infrastructure, data collection, model calibration, training, model application and interpretation, insurance pricing, marketing, and monitoring.

Perhaps the most difficult problem is that insurers do not regard WII as a profitable line of business. Most of those involved in early pilot projects have dropped out. There is no evidence of commercially sustained investment in the product by insurance companies. In this circumstance, some observers are suggesting a retreat to public support for catastrophic weather index programs linked with funding for drought and flood relief.

Despite these findings, donor investments continue to support the establishment of new weather insurance projects in many countries. It is not clear whether these continuing investments reflect a lack of adequate information about past failures, a view that past problems are being resolved with further experimentation, or perhaps subsidies are justified by some larger public good. A brief field mission was launched to assess whether more recent efforts are becoming more successful. Are the many problems highlighted in the literature being resolved? Are public investments more clearly justified by welfare gains in rural farm communities?



3 Case Studies

This section presents the findings of a field visit to four countries in Sub-Saharan Africa with active weather insurance programmes in June 2016: Kenya, Tanzania, Zambia, and Zimbabwe. The visit allowed for the updating of data on these programmes, including numbers of farmers covered, insurance value, evidence of technological change, levels of continuing subsidy, and the prospect for commercial sustainability.

The methodology used in the field visits consisted of a survey form that was completed by insurance companies to capture basic data on the performance of the pilot projects. Additionally, interviews were conducted with a limited number of partners participating in each of the pilot projects under assessment. Some of the institutions involved provided documentation on the projects as well.

As is the case with any quick review, this assessment was highly dependent on the accuracy of the information provided by the informed observers, including participants in pilot projects, who completed the surveys and took part in interviews. Some of the results may have been biased by the implementing agencies' interest in protecting their funding. Even so, many of these results were more negative than anticipated.

3.1 Case # 1: Kenya-Seed Co Limited / replanting guarantee

Product name

Replanting guarantee

Type

Seed protection

Insurer

UAP Kenya Insurance Company Limited
Swiss Re, reinsurer

Participating partners

- Agriculture and Climate Risk Enterprise (ACRE), promoter and technical services provider
- Agricultural Market Development Trust (AGMARK), NGO hired to implement awareness and educational campaign to farmers
- SafariCom, provider of mobile phone money transfer system (M-Pesa)
- Seed Co and donors, subsidizing premiums to farmers

Insured crop

Maize

Clients

4,400 farmers (2014)

3.1.1 Brief description / strategy

This WII product covers the value of purchased seed against drought risk for the first 21 days of the crop cycle. Seed Co has placed a scratch-off voucher with a code in each two-pound bag of seed. The farmer interested in obtaining the insurance dials a telephone number and enters the code. The mobile network picks up the location where the phone call is made, and the farmer is insured as a beneficiary of the policy for that location. ACRE designs and prices the contracts using satellite weather data, with the assistance of the International Research Institute of Climate and Society (IRI) at Columbia University.

The insurance was free to farmers. The seed company and donors jointly pay an aggregated risk premium (of around 10%) to the insurer at the beginning of the seed sales season. Payouts are made to registered farmers if there is not enough precipitation for seed germination during the 21 days of the planting window. The compensation is sent to farmers via mobile money, allowing them to purchase new seeds and replant in the same season. Farmers can also simply accept the cash as compensation.

Seed Co incurred higher costs from repackaging their seeds to include the insurance voucher and paying their share of the premium. The company justified this expense in terms of market differentiation, securing customer loyalty, and increasing market share in Kenya (currently only 5%) through promotion of their drought-resistant seeds.

ACRE hoped to promote simplicity, replicablility, and easy packaging of WII as a strategy to encourage farmers to buy insurance, potentially creating a future demand for more complex insurance coverage.

3.1.2 Outcome

The initiative demonstrated that mobile banking could be used to facilitate insurance transactions, eliminating the need for an insurer to have direct contact with farmers. This has allowed for the piloting of replanting guarantee insurance products in Rwanda, Tanzania, and Kenya. Table 3 shows the performance estimations for this product for Kenya alone in 2014.

Table 3: Kenya / replanting guarantee insurance for 2014

# of bags sold with voucher (estimated)[8]	400,000
# of farmers with access[9]	200,000
# of bags registered[10]	8,800
# of farmers registered[11]	4,400
Premiums paid[12]	$3,520
Sum insured per farmer[13]	$9
# of farmers received payouts[14]	540
# of farmers that repeated[15]	39

Information bulletins about the programme identify the number of farmers who have had access to the insurance—about 200,000. However, only about 4,400 farmers (about 2 percent of the target population of seed buyers) chose to obtain the free insurance by texting the voucher code. In addition, approximately 1.4% of farmers who bought insured bags of seeds attempted to register but failed to do so successfully. These results are estimates based on the analysis made by GSMA (2015) of the registration logs and system registration data of the mobile platform, as ACRE declined to disclose the actual information for this product in a disaggregated form. ACRE claimed that in 2015 the number of farmers registering rose to 8,000.

The extremely low rate of registration for this free insurance product remains a puzzle. Registration would seem to be a positive value proposition for farmers. The effective cost to farmers was the price of a text message. No explanation has been found for this outcome.

3.1.3 Key issues

Very low uptake. Kenya has a high density of agro dealers operating in the rural sector. The combined density of seed sellers, mobile phone use and familiarity with mobile banking offers insurance companies an unusual opportunity to reach larger numbers of farmers cost effectively. The very low registration rate among farmers, however, shows that this contact and marketing mechanism needs to be dramatically improved. Additionally, the fact that many farms tried but failed to register indicates that glitches in the system remain. Seed Co, which is participating in the insurance programme as a strategy to differentiate itself from competitors, must rely on further research to identify the causes of these issues.

8 This estimate comes from the number of packets of seeds sold, and number of cards printed.

9 Assuming every farmer buys 2 bags of seeds.

10 SMS registration logs + system registration data.

11 Farmers that actually scratched the card and successfully registered.

12 Based on a value of US$4.5 per bag and 10% premium rate.

13 Assuming every farmer buys 2 bags of seeds.

14 SMS registration logs + system registration data.

15 Users that have re-registered a packet of seeds after payout, either within the same or next season.

Replication of this model in countries with a much lower density of agro dealers will prove to be significantly more challenging, as evidence from ACRE's programmes in Tanzania already indicates.

Commercially unsustainable. ACRE's revenue depends on the volume of registrations and on the average premium, both of which are very low, leaving the firm unable to cover its fixed costs. As a result, donors are continuing to subsidise the cost of technical services and marketing. The insurer, UAP, expects high loss ratios and does not consider WII as a profitable line of business.

Given that the project depends on the cooperation of a few key partners, the failure of one to participate fully can have a strong negative impact. In particular, the heavy reliance on Seed Co, which is participating in the insurance programme in order to better market its seeds, may leave the project especially vulnerable.

Basis risk. Given the design of the project, basis risk is a particular concern. First, if the farmer sends the text message from a location other than the farm where the seed is planted (e.g., a distant retail shop where the seed is purchased), the mobile platform might register the wrong location. Second, and more importantly, the mobile platform is not equipped to register the actual planting day, which is crucial given the 21-day coverage period. After preparing the soil, farmers usually wait until the right conditions for planting appear, and this time which might not coincide with the sowing window used by the model or the date of registration.

Impact. There are no data to show the level of awareness or understanding of the WII vouchers among farmers who bought seeds. The ability to replant after a payment is received will depend on how quickly payouts are triggered and the money delivered via mobile phones. It is reported by GSMA (2015) that only 7% of farmers who received payment replanted their crop in the same season.

3.2 Case # 2: ILRI / Kenya Index-Based Livestock Insurance (IBLI)

Product name

Kenya Index-Based Livestock Insurance (IBLI)

Type

Yield protection

Insurers

APA Insurance,

Takaful Insurance of Africa (TIA)

Participating partners:

- International Livestock Research Institute (ILRI), providing the technical expertise for contract modelling, data management, and monitoring.
- Donors: USAID, European Union, Australian Aid, UKAid, World Bank

Insured crop or livestock

Cattle, camels, sheep and goats

Clients

6,105 farmers (2015)

3.2.1 Brief description / strategy

This insurance programme has evolved in a short period from one designed for catastrophic events covering animal mortality to an asset protection product that now covers losses caused by drought-induced stress on animals. This product uses satellite observations to derive the NDVI as a proxy for the vigour of pastures. A model is used to correlate the NDVI with livestock mortality or animal stress caused by unavailability of forage. The product was developed by ILRI and sold to individual pastoralist households in various districts of Kenya at subsidised levels of around 40% of commercial premiums. Pastoralists are the policyholders, and they pay the risk premium. These premiums are equal to approximately 8% of the value of livestock insured. Donor agencies pay a subsidy covering 40% of the costs insurers face in setting up and operating the programme.

The programme started with initial contributions from the World Bank, which fully covered the research and design of the index model and a willingness-to-pay study. Other funds were available for the research infrastructure and an impact assessment. Other donors have subsequently funded the further development of this insurance model and the premiums. The programme started in 2010 and is now available in several regions of northern Kenya. Technical progress has been made, but the project needs additional improvements. For instance, the index still does not have the precision to specify if a particular level of greenness indicates that the forage is edible or palatable to cattle, as the filters used to interpret the satellite observations do not make this distinction.

The contract has evolved from a mortality contract to one of asset quality protection. ILRI initially piloted a mortality index in Marsaibit, Kenya, because mortality data was available there. But this type of historic mortality data was not available in other regions being considered for piloting. More significantly, herders and insurers expressed little interest in the mortality product. This situation forced planners to adopt a new strategy that considered asset protection.

In its current form, the index acts as an early detection system that triggers payments before mortality happens. This contract should provide herders with payments early enough that they could help animals suffering from a lack of pasturage and keep them alive.

UAP insurance initially participated in the programme with Equity Bank, but Equity pulled out after two years after seeing lower returns than expected. The insurance companies APA and Takaful Insurance of Africa (TIA) continue marketing this product, relying on donor resources for premium subsidies, training, capacity development, and implementation support. The two insurers are obtaining resources from donors to set up their departments of index insurance.

In 2015, the government bought the product to protect 5,000 vulnerable households against drought events as part of the government social safety net. In effect, this private insurance policy is becoming a public safety net policy.

3.2.2 Outcome

The IBLI programme has reached a clientele of more than 6,000 pastoralists, and 5,000 more are covered under a separate government programme. Table 4 summarises the performance of this insurance programme through the years.

Table 4: Kenya / Livestock Index Insurance (IBLI)

	2012	2013	2014	2015
# of insured farmers[16]	216	500	101	6,105
Total sum insured	$82,220	$335,647	$500,301	$3,382,904
Total premiums[17]	$3,546	$22,815	$36,405	$269,865
Premium subsidy	40%	40%	40%	40%
Payouts to farmers	$15,026	$672	$33,250	$114,336
Loss ratio	424%	3%	91%	42%

Source: ILRI

This programme has been growing since its inception in 2011, thanks to the substantial support provided by donors for research infrastructure, contract design, platform monitoring, awareness programmes, training, direct support to insurers, and premium subsidies.

Kenya experienced a severe drought in 2012 during the first testing of the pilot in Marsabit, and every policyholder was paid, resulting in a massive 424% loss ratio to insurers. In every subsequent season there has been at least one livestock unit that has received payments. The insurance companies have experienced high loss ratios, and have not made any profit. Their operational costs are higher than the premiums they are paid. The high costs result from the need to deliver individual insurance contracts to widely dispersed herders in remote areas with inadequate roads and phone network coverage. Moreover, Northern Kenya is prone to frequent catastrophic drought events. These conditions are not optimal for developing sustainable commercial insurance.

16 It does not include the government insurance programme of 5,000 farmers in 2015.

17 Estimated average premium rates of 8% for latest years.

3.2.3 Key issues

Low uptake. Very low uptake of IBLI shows pastoralists see little value proposition in the product, despite premium subsidies of 40%.

Undertaking complex challenges. This programme undertook two very complex challenges: first, to build an index model using satellite data that correlates with livestock mortality with a high degree of precision; and, second, to provide an insurance programme in a location prone to frequent, severe-intensity droughts. These complications are magnified by the target zone being large in size and characterised by scarce road, communications and banking infrastructure.

Commercially unsustainable. The environmental conditions virtually eliminate any possibility of making this product commercially sustainable. Given the operational costs for insurers, in the absence of subsidies the premium rates would raise to prohibitive levels. Donors are maintaining high levels of subsidies for the development and operation of the underlying weather model, for insurers administrative costs, and for subsidizing the premiums. The programme has heavy R&D costs, frequent payouts and high loss ratios for insurers, and very high operational costs.

Basis risk. Predicting livestock mortality is technically complex, and predicting animal stress is even more difficult, especially in a region where herders move large distances and the health records of the herds are unreliable. As a result, basis risk is considerable.

3.3 Case # 3: Tanzania-Cotton Board / insuring input loans

Product name

Weather index insurance for cotton farmers

Type

Inputs credit protection

Insurer

APA insurance

Africa Re, reinsurer

Participating partners

- Afrisian Ginning Limited, distribution channel
- Gatsby Foundation and Tanzanian Cotton Board, promoters of project

Insured crop

Cotton

Clients

337 cotton farmers (2013-14 season)

3.3.1 Brief description / strategy

This insurance product was designed to protect cotton farmers from prolonged dry spells (between December and May) and from excess rainfall (between February and May). It covered the value of inputs provided on credit by ginners. This project used satellite-based rainfall estimations for predicting yields during the various phases of the crop cycle. The goal was to encourage the use of improved inputs in cotton production by reducing the riskiness of these investments – at least those caused by poor rainfall. Under this strategic objective, in 2011 the Gatsby Charitable Foundation (Gatsby) commissioned MicroEnsure to develop and pilot WII products for cotton farmers in Tanzania.

This product was designed and implemented by MicroEnsure with the participation of APA insurance and the cotton ginner Afrisian. It was promoted by Gatsby Foundation and the Tanzanian Cotton Board. The pilot was tested during the 2013-14 cotton season only. It failed and is no longer on the market.

The Tanzanian market strategy for MicroEnsure was to identify an agricultural supply chain where service providers—cotton ginners in this case—could advance an upfront payment of premiums before the season starts, and discount that amount from farmers at the end of the season when they deliver the seed cotton to ginneries. MicroEnsure experimented with eight different models of rainfall index in order to identify one that correlated closely with the historical yields of farmers. Ultimately, an index using TAMSAT satellite data was selected because it covers Sub-Saharan Africa and it is publicly available from the University of Reading, partnering with MicroEnsure. Insurance products were developed for eight locations in Kwimba District. The insurance was underwritten by APA Insurance and reinsured by Africa Re.

3.3.2 Outcome

This pilot was marketed during the 2013-14 season, initially aiming to attract around 10,000 farmers and five ginneries. Those targets proved to be far too ambitious: Only one ginner, Afrisian, participated, and only 337 farmers were insured. Table 5 shows the performance of the product for that season.

Table 5: Tanzania / cotton index insurance*

	2014
# of insured farmers	337
Total sum insured	$6,411
Total premiums	$385
Premium rate	5.8%
Premium subsidy	0%
Payouts to farmers*	$494
Loss ratio	128%
* Converted to US$ at average November 2014 rate.	

Source: Gatsby Foundation

The disappointing uptake numbers can be partly explained by a lack of clarity regarding responsibilities and coordination among the participating partners. First, Afrisian decided which of its farmers would receive insurance coverage. Only "trusted" farmers who had been working with Afrisian for many years and had good repayment track records were selected. Second, Afrisian paid all premiums upfront and, for unknown reasons, did not deduct this amount at harvest. In effect, the company provided mandatory free insurance to the selected farmers. None of the insured farmers were even aware that their loans had been insured. Third, two payouts were triggered related to dry spells in the areas of Kikubiji and Shilembo in April 2014, resulting in total payouts due to farmers of TZS 801,360 ($494). However, because of disputes between MicroEnsure and the insurer, no payouts had been made to Afrisian or the farmers after a year. Gatsby's contribution towards the pilot has been $180,000.

3.3.3 Key issues

Lack of value proposition. Reliance on an integrated agricultural supply chain as a distribution channel for testing a pilot projects appears to be inadequate. The low participation of ginneries shows that this contract did not represent any value proposition to the suppliers or to their farmers. It is known that the most important issue for credit risk in cotton supply chains in Africa is side selling, in which the farmer breaks a loan agreement with a particular ginner to sell to another party. This might explain why the ginner insured only those farmers with good repayment track records.

Weather is not main risk. MicroEnsure was able to engage only one distribution partner, despite originally aiming for four. The ginners MicroEnsure met with were more concerned about risks other than weather, such as side selling, fake seeds, and the timely availability of inputs. Ginners were also reluctant to finance premiums upfront. This shows that the pilot project did not begin with a clear understanding and assessment of risks along the cotton supply chain and the corresponding problems stakeholders are facing.

Basis risk. A review done by the University of Reading on satellite weather observations derived from TAMSAT cautioned that these observations have only moderate accuracy for measuring rainfall of higher intensity. This opens the possibility of significant basis risk for intense rainfall events. Additionally, the predictive accuracy is likely to vary regionally and seasonally. Users are therefore advised to validate any indices they derive from TAMSAT daily data against gauge observations. However, the low density of weather gauges in Tanzania undermines the opportunity to pursue such ground-truthing.

3.4 Case # 4: Zambia-NWK-Musika / insuring input loans

Product name

Musika-NWK weather index insurance for cotton

Type

Inputs credit protection

Insurers

- Focus General Insurance Limited
- Mayfair Insurance

Participating partners

- Musika, an NGO that funds and promotes the product
- NWK Agri-services, the WII delivery channel and input credit provider
- GIIF funding MicroEnsure, the design and launching of the initial pilot project, and for marketing
- RiskShield Company for the design of contracts

Insured crop

Cotton

Clients

52,000 cotton farmers (2015)

3.4.1 Brief description / strategy

This weather insurance product is designed to protect the value of inputs supplied on credit by NWK Agri-services to cotton farmers. It uses satellite weather data estimates to price the risk and monitor the contract, protecting farmers throughout the crop cycle. It measures cumulative rainfall over 20 days for drought-prone periods of the crop cycle and triggers payments when precipitation is less than an agreed percentage of normal. The index also measures cumulative rainfall over ten consecutive days for some periods of the crop cycle that have risk of excess precipitation, triggering payments when precipitation reaches some agreed percentage over normal rainfall levels. The WII policy is being promoted by NGO MUSIKA, with the participation of input supplier NWK, as well as Mayfair and Focus insurance companies as underwriters. Farmers are charged an unsubsidised premium rate of around 8% of the value of the insured product, advanced by NWK at the beginning of the season as part of the credit for the supply of inputs. The enrolment of farmers in this insurance scheme is voluntary. NWK advances the premiums upfront to the insurer at the beginning of the season and recovers those premiums from the ginneries that receive and process the seed cotton farmers deliver at the end of the season.

As an NGO that provides technical and financial support to agribusinesses testing the market, Musika wanted to complement its services with agricultural insurance to protect investment initiatives. Its strategy required an insurance distributor with a wide outreach to farmers, and NWK offered a good fit because all cotton farmers use improved seeds and fertilizers. NWK, a supplier of improved seeds with a market share of around 25%, saw WII as an opportunity to protect their credit and retain their clients.

In 2012 Musika offered a $160,000 grant to MicroEnsure for its assistance in developing WII for cotton growers. MicroEnsure offered bundled micro life insurance and micro WII as part of its promotional strategy in Zambia. After experience commercial difficulties, however, MicroEnsure pulled out of the market.

Donors and Musika stepped in to support the establishment of a new local company, RiskShield, to provide technical support services in contract design, actuarial analysis, and contract pricing previously obtained from Microensure. Focus General Insurance and Mayfair Insurance stepped in to offer the WII contracts.

3.4.2 Outcome

The commercial viability of this programme remains highly uncertain. NWK, as the input and credit supplier, finds that it has protection for its loans. Participating farmers are protected from accumulating debt with the input supplier in the event of adverse weather events. Table 6 shows the performance of the product during its three-year history.

Table 6: Zambia-NWK / inputs credit insurance for cotton farmers

	2013-14	2014-15	2015-16
# of insured farmers	6,610	3,092	52,000
Total sum insured	$173,645	$84,948	$1,377,886
Total premiums	$13,892	$6,796	$121,055
Premium rate	8.0%	8.0%	8.8%
Payouts to farmers	$22,863	$5,684	n/d
Loss ratio	165%	84%	n/d
Exchange rate: $1 = ZMW10.9			

Source: Focus insurance

The growth rate of this product has fluctuated drastically during its short time in the market. The drop in insured farmers in 2014 seems to have been caused by management changes at NWK that resulted in hesitations about the programme. The episode reveals the fragility of the programme, given that only one input supplier is participating. The impressive jump in uptake in 2015 can be attributed to the early announcement of a severe drought event for the 2015-16 cropping season.

Cargill, the main competitor of NWK, has expressed interest every season since the programme started but has ultimately declined to participate each time.

Both Mayfair and Focus General recognise that they are not making any profit from this product. They had heavy losses in 2013-14 and are expecting higher losses in 2015-16. The insurers are proposing to raise premium rates and request the government to subsidise those increases, because they fear farmers will not be willing to pay higher than current premium rates of over 8%.

3.4.3 Key issues

Commercial sustainability. This WII product has not proved to be commercially sustainable. Insurers have suffered high losses and have strongly suggested the need for substantial increases in premium rates. No estimation of such increase has been provided, but any substantial increase will likely reduce the willingness of farmers to pay, according to partners. In these conditions, insurers will soon lose interest.

Supply chain structure. The structure of the cotton supply chain has encouraged insurance transactions in which the input supplier makes a large upfront payment of premiums and then recovers the credit and the insurance premiums when it collects harvested crops from farmers. This model, however, is unique to the cotton supply chain, which means it would difficult to replicate with other crops. NWK has set a maximum number of 72,000 insured farmers a year. Given that 52,000 bought insurance in 2015, the opportunity for growth is limited.[18]

Limited participants. The participation of only one input supplier and, effectively, only one insurer (Focus) indicates problems for the sustainability of this product. The programme depends upon the willingness of NWK to keep advancing premiums at the beginning of the season, and of the insurer to keep marketing an unprofitable product.

Adverse selection. The high demand for this product in 2015 may have reflected farmers' expectations of a severe drought in that year. The value proposition for farmers under normal conditions—when no severe drought has been predicted—remains to be seen.

3.5 Case # 5: Zambia-MoA-Musika / insuring inputs support voucher

Product name

Government Subsidy Voucher insurance

18 The WII for the voucher support program that is discussed below uses a different distribution model, where the government advances liquidity to farmers upfront (with a subsidy voucher) and farmers can choose to buy insurance with the voucher, because insurance is an eligible expense.

Type

Yield protection

Insurer

- Mayfair Insurance

Participating partners

- NGO Musika as insurance promoter
- Ministry of Agriculture, issuing inputs subsidy vouchers
- Risk Shield, contract design
- GIIF (IFC), funding Mayfair Insurance

Insured crop

Maize (60% premium subsidy)

Clients

1,500 (2015-16)

3.5.1 Brief description / strategy

The Government of Zambia has been providing subsidies for the purchase of agricultural inputs to smallholder farmers for several years. At the beginning of the 2015-16 cropping season, approximately 230,000 farmers received these subsidies in the form of pre-paid bank cards with a value of around $210 per beneficiary (this amount includes the government subsidy and a small contribution from the farmer). Farmers can use the cards to buy a wide range of agricultural inputs and assets (such as chemicals, cattle, and equipment.) Approximately 1,500 of those farmers participated in a new pilot project that enabled them to use the bank card to buy WII coverage. Any insurance payouts are to be deposited on the farmer's bankcard.

This insurance covers the value of the input subsidies the farmers receive from the government. It uses satellite-based weather data for pricing and monitoring of the contracts, which are designed by RiskShield. It provides protection against weather risks for the duration of the crop cycle.

The WII contract is a modified version of the WII contract model sold to NWK cotton farmers. A key modification was the introduction of a field assessment in cases where the rainfall levels are close to the index's trigger point but do not trigger any payments.[19] In such cases, if the field assessment reveals damages, the insurance will cover 30% of the sum insured. This change was introduced in an attempt to manage basis risk.

3.5.2 Outcome

When this report was prepared, insurers were finalizing the field assessments and processing the claims. As a result, no precise performance indicators were available. Partners indicated, however, that there were payouts in several areas, and the insurer was expecting large losses.

3.5.3 Key issues

Insurable interest. Farmers use their subsidy voucher to purchase a wide range of inputs. The WII is intended to protect the value of the subsidised government voucher ($210), but it is difficult to assess precisely what the insurance will cover. This is because farmers can use the subsidy to buy a wide variety of services and items (seeds, fertilizer, equipment, livestock, parts, services, etc.) that are impacted differently (or not impacted at all) by a drought or rainfall excess.

Basis risk. Farmers grow a wide variety of crops, not just maize. Basis risk has been magnified by lowering the triggers of the existing contract model and by using it to protect the value of a wide range of farming assets and many different crops.

Non-necessary additional steps. Introducing field assessments as part of the WII contract essentially converts it into a traditional indemnity-based contract, resulting in higher operational costs. It could also open the door to fraud. Field

19 There was not available information what percentage close to the trigger point would warrant a field assessment.

evaluations of small plots over the wide geographical area where vouchers are distributed will be complex and difficult to manage.

Commercial sustainability issues. Insurers are demanding increases in the premium rates because the current WII contracts have proven to be unprofitable. The field assessments will raise operational costs, especially if coverage is extended across the large region where subsidies are distributed. The intended premium increases would need to be substantial to cover these additional operational costs. It is difficult to see a path to profitability for insurers.

3.6 Case # 6: Zimbabwe-ZimNat Lion / input credit insurance

Product name

Weather index insurance for farmers

Type

Inputs credit protection

Insurer

ZimNat Lion Insurance Limited

Swiss Re, reinsurer

Participating partners

- MicroEnsure, contract design and training for stakeholders
- FAO, promotion and funding for initial piloting
- Agricultural input providers (details not available)

Insured crop

Maize

Clients

3,700 farmers (2014-15)

3.6.1 Brief description / strategy

In 2012 ZimNat Lion insurance became interested in testing FAO-supported WII pilot projects in Zimbabwe. The plan was to use agricultural input providers as distribution channels for the insurance product. This project started in the district of Chiweshe with a few hundred individually selected smallholder farmers during the 2013-14 agricultural season. With promotion by FAO and funding from the Dutch government, the programme involved the installation of weather stations, training, contract design, contract marketing, and subsidies covering 50% of the premium costs.

The programme expanded in the 2014-15 season to include four additional districts and large-scale commercial farmers, with higher sums insured. The product was sold to 3,700 farmers during that season. ZimNat used brokers to underwrite contracts for the commercial farmers.

The WII product protects maize yields for the duration of the crop cycle. It offers triggers for drought protection during germination at the sowing window, as well as for dry spells or excessive rainfall after germination. It uses rainfall data from field weather stations for pricing and for monitoring the contracts. The insurance is bought by farmers on a voluntary basis. Agricultural lenders who provide inputs to farmers pay the premiums of 6% upfront at the beginning of the season, and the premium rate is added to the loan. Participating partners are ZimNat Lion insurance and credit providers.

3.6.2 Outcome

In the 2013-14 season the product was tested with a few selected participants with premiums subsidies of 50%. In the following season, 3,700 farmers bought the product with no premium subsidies. According to ZimNat, the first year went relatively well, but in the 2014-15 season it had to make large payouts. ZimNat suspended the product for the 2015-16 season due to predictions of severe drought. The performance of this product for the 2014-15 crop season is shown in Table 7.

Table 7: Zimbabwe-Zimnat / input credit insurance

	2014-15
# of insured farmers	3,700
Total sum insured	$5,000,000
Total premiums	$300,000
Premium rate (%)	6
Payouts to farmers	$3,300,000
Loss ratio (%)	1,100

Source: Estimations based on interview with ZimNat representative

It is unlikely that ZimNat will offer this product again. When ZimNat staff went to the field to assess damages at commercial farms, they found that losses were far less severe than what the trigger indicated. As a result, the company sees substantial flaws in the design of the index.

ZimNat reports that the following issues must be addressed before it would consider returning to the market: (i) introduction of a hybrid product with an initial index trigger than can be followed up by field assessment and indemnity-based payouts; (ii) readjustment of the trigger points to allow for higher risk retention by farmers; this would change the product into a type of catastrophic insurance; (iii) limiting the maximum payout to 60% of total loss; and (iv) adjusting prices to address the issue of profitability.

3.6.3 Key issues

No commercial sustainability. In its one season on the commercial market, this product witnessed monumental losses, particularly from the contracts sold to commercial farmers with higher liabilities. Stakeholders remain discouraged by this initial outcome. It is unlikely they will return to the market unless the concerns expressed by the insurer are addressed.

ZimNat does not see this is a viable commercial product. It is revising its strategy and may begin to view WII as part of its corporate social responsibility initiatives. This might involve working only with smallholders and requesting government support. The company does not see WII as viable without increases in premium rates as well as premium subsidies.

Technical flaws in contract design. This product was a failure partly caused by flaws in the design of the index, as indicated by field assessments at commercial farms. Making the changes indicated by the insurer would create what is essentially a new product. ZimNat does not have the capacity to design WII contracts. The original design was drafted by consultants supported by MicroEnsure.

3.7 Case # 7: Zimbabwe-EcoSeed / agriculture weather insurance

Product name

EcoFarmer

Type

Seed protection, yield protection

Insurer

None

Participating partners

- EcoNet, provider of mobile payment system Eco Cash
- Seed Co, subsidizing premiums to farmers

Insured crop

Maize

Clients

435 farmers (2014-15 season)

3.7.1 Brief description / strategy

EcoFarmer insurance offers two options: coverage for the value of purchased maize seed ($25 premium), or yield protection covering the value of the harvest derived from planting ten kilogrammes of maize seed ($100 premium).

Five prototype policies were designed for the initial testing. For the yield protection option, farmers can buy insurance by paying eight cents per day, with the amount deducted from a prepaid phone account. The initial date of the insurance cover is when 30 millimetres of rainfall is received over three days within the planting date range for each location. The end date of the coverage is 120 days after the start of the season. The trigger for excessive rainfall is when 50 millimetres of rainfall is recorded every day over six or more consecutive days within 50 days of the start of coverage. The trigger for rainfall deficit is when a subscriber receives less than 2.5 millimetres of rain per day over 23 days. The maximum payout is $100 for every 10-kilogram seed pack planted.

Econet partnered with Seed Co to produce and market special seed packs containing an insurance voucher. Farmers interested in purchasing the insurance must send a text message to the telephone number provided on the voucher.[20] When it receives the text message, Econet records the voucher number and registers the location of the farmer. Econet uses its own network of weather stations, which are supervised by the Meteorological Services Department. Weather records are used by weather consultants to determine whether rainfall patterns reach thresholds requiring payouts. The pilot was tested in Mashonaland East province for the seasons 2013-14 and 2014-15.

Econet did not reach agreement with any insurer to underwrite the contracts for this pilot. It nevertheless secured regulatory approval for a self-captive arrangement under micro insurance regulation, with no insurer participation.

3.7.2 Outcome

This pilot project met considerable operational and coordination challenges. It insured only 1,100 farmers in its initial year, and the number of insured dropped to 435 farmers for the 2014-15 season. This pilot failed. The available details of performance of this product are presented in Table 8.

Table 8: Zimbabwe-Econet Weather Index Insurance

	2013-14	2014-15
# of insured farmers	1,100	435
Total sum insured	$60,000	n/d
Pay-outs to farmers	$1,200	none

Source: PowerPoint presentation by Beniah Nyakanda of Econet, March 2016.

Discussions with stakeholders revealed difficulties with data. Limited weather data was available from field gauges for contract design and pricing, and a low density of weather stations made it difficult to interpolate data and fill data gaps.

3.7.3 Key issues

Many complexities. Although EcoFarmer intended to draw upon its experience in using a mobile platform in Kenya, it ended up offering a highly complex product requiring high levels of technical expertise in both design and monitoring. The project may have been too ambitious, especially given the lack of an insurer.

Low uptake. The uptake of only 1,100 farmers for the first experimental year is understandable. But the drop to only 435 farmers the following year—after there had been time to fix glitches and conduct more effective marketing—indicates that farmers did not see a value proposition in the product.

20 Only 21% of adults in Zimbabwe have mobile accounts, according to the World Bank Global Findex data from 2014. In Kenya, by contrast, that figure is 58%.

4 Conclusions

This assessment shows that despite the extensive testing of various models and substantial financial support from donors, the commercial development of WII has failed.

In particular:

The experience of agriculture WII projects designed to protect smallholders in developing countries shows that most pilot projects have failed. Few farmers have shown interest in these policies, even when provided with substantial subsidies. However, donor funding continues to support experimentation with an evolving set of new WII initiatives.

None of the insurance companies in Sub-Saharan Africa consider WII a profitable line of business. The industry has experienced high losses. The expansion of interest in WII shown in a few pilots depends on substantial funding provided by donors to support the development and refinement of the WII model, data processing, educational and awareness programmes, marketing, and contract monitoring. There is no indication that insurers will invest in independently developing the WII market. Most will consider this product only as part of their corporate social responsibility policies.

In most cases, small-scale farmers show a very low appreciation and demand for the product even when it is offered for free. Despite pilot testing of many types of WII products in low-income countries for over a decade, its uptake has been far below expectations. The few cases where index insurance has been widely accepted were in cases where it was either free or heavily subsidised.

Farmers who received subsidised insurance tended to undertake riskier agricultural activities than those uninsured. However, there is no evidence that WII can support expanding investment in more climate smart agricultural technologies.

A long list of key problems has not been solved. This review highlights a long list of problems that will be difficult to solve. The issues include technical barriers (especially availability and reliability of data and the accuracy of indexes), a lack of demand among farmers, unavailability of logistical support, and lack of profitability of the products.

There are no clear signs that WII has potential to become a commercially sustainable solution for poor smallholders to manage weather risks. Based on the findings of this assessment, the overall conclusion is that WII products at the individual farmer level do not show the potential to become practical products that can be widely and reliably used as part of a strategy to effectively manage weather risk and make a meaningful contribution to strengthening the resilience of smallholders in Sub-Saharan Africa.

Bibliography

Alderman, H., & Haque, T. (2008). Insurance against covariate shocks. World Bank working paper, 95.

Binswanger-Mkhize, H.P. (2012). Is there too much hype about index-based agricultural insurance? *Journal of Development Studies*, 48, 187–200.

Brans, M.V., Tadesse, M., & Takama, T. (2010). Community-based solutions to the climate crisis in Ethiopia. In: R. Fujikura, R., & Kawanishi, M., (Eds.) *Climate change adaptation and international development: Making development cooperation more effective* (pp. 217-238). London: Earthscan.

Cai, J., de Janvry, A., & Sadoulet, E. (2014). Social networks and the decision to insure. *American Economic Journal: Applied Economics*, 7(2), 81-108.

Carter, M., de Janvry, M., Sadoulet, E., & A. Sarris, A. (2014). Index-based weather insurance for developing countries: A review of evidence and a set of propositions for up-scaling. *Development Policies Working Paper*, 111.

Carter, M. (2009). Intelligent design of index insurance for smallholder farmers and pastoralists. In: Hill, R.V., & Torero, M. (Eds.) *Innovations in insuring the poor*, Focus 17-06. Washington, DC: IFPRI.

Clarke, D., Mahul, O., Rao, K., & and Verma, N. (2014). Weather based crop insurance in India. *World Bank Policy Research Working Paper* (5985).

Clarke, D. (2011). A theory of rational demand for index insurance. *Series Working Papers* 572, Economics Department, Oxford University.

Cole, S., Giné, X., Tobacman, J., Topalova, P., Townsend, R., & Vickery, J. (2013). Barriers to household risk management: evidence from India. *American Economic Journal: Applied Economics*, 5(1), 104-135.

Dercon, S., Hill, R.V., Clarke, D., Outes-Leon, I., & Taffesse, A. S. (2014). Offering rainfall insurance to informal insurance groups: evidence from a field experiment in Ethiopia. *Journal of Development Economics*, 106, 132-143.

Giné, X., & Yang, D. (2009). Insurance, credit, and technology adoption: Field experimental evidence from Malawi. *Journal of Development Economics*, 89(1), 1-11.

Giné, X., Vickery, J., & Cole, S. (2016). How does risk management influence production decisions? Evidence from a field experiment. Update of *World Bank Policy Research Working Paper* 6546 (2013).

GSMA (2015). *Micro insurance in mobile agriculture. Case study & takeaways for the mobile industry*. Nairobi, Kenya: Kenya-ACRE.

Hazell, P. B., & Hess, U. (2010). Drought insurance for agricultural development and food security in dryland areas. *Food Security*, 2(4), 395-405.

Hazell, P.B. (1992). The appropriate role of agricultural insurance in developing countries, *Journal of International Development*, 4(6): 567-81.

Hill, R. V., & Torero, M. (2009). *Innovations in insuring the poor*. Washington, D.C: International Food Policy Research Institute.

Kapphan, I. (2011). Optimal weather insurance design: A quantitative exploration. *MSSANZ: Modelling and Simulation Society of Australia and New Zealand*.

Karlan, D., Osei, R., Osei-Akoto, I., & Udry. C. (2014). Agricultural decisions after relaxing credit and risk constraints. *The Quarterly Journal of Economics*, 129(2), 597–652.

Laajaj, R., & Carter, M. (2009). Using satellite imagery as the basis for index insurance contracts in West Africa. BASIS letter (March 7, 2009), University of Wisconsin-Madison, Department of Agricultural and Applied Economics.

McInstosch, C. (2016). *Weather index insurance, risk, and agriculture* [Powerpoint presentation]. Washington, D.C.: The World Bank.

Mobarak, A. M., & Rosenzweig, M. (2012). Selling formal insurance to the informally insured. Department of Economics Working Papers 97, Yale University.

Osgood, D., McLaurin, M., Carriquiry, M., Mishra, A., Fiondella, F., Hansen, J., ... & Ward, N. (2007). Designing weather insurance contracts for farmers in Malawi, Tanzania and Kenya. *Final Report to The Commodity Risk Management Group*, ARD, World Bank.

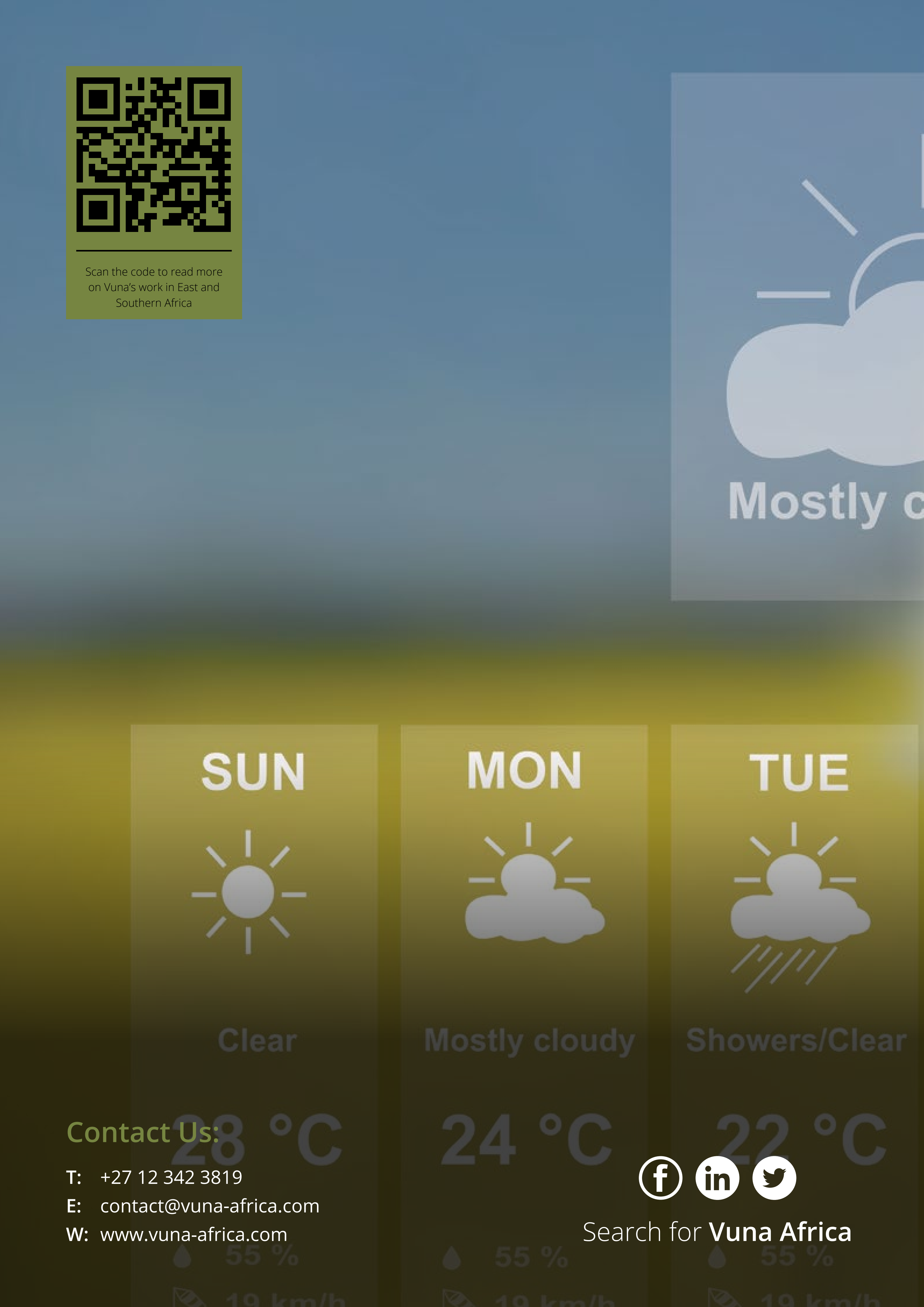
Tadesse, M. A., Shiferaw, B. A., & Erenstein, O. (2015). Weather index insurance for managing drought risk in smallholder agriculture: lessons and policy implications for Sub-Saharan Africa. *Agricultural and Food Economics*, 3(1), 26.

Turvey, C.G. (2008). The pricing, structure, and function of weather-linked bonds, mortgages, and operating credit. *AgriFinance Review* 68(1):135-150.

Turvey, C. G., & Mclaurin, M. K. (2012). Applicability of the normalised difference vegetation index (NDVI) in index-based crop insurance design. *Weather, Climate, and Society*, 4(4), 271-284.

World Bank (2005). Managing agricultural production risk: innovations in developing countries. *Agriculture and Rural Development (ARD) Department Report*, (32727-GLB).

World Bank (2011). Weather index insurance for agriculture: guidance for development practitioners. *Agriculture and Rural Development Discussion Paper*, 50.



Scan the code to read more on Vuna's work in East and Southern Africa

Contact Us:

T: +27 12 342 3819
E: contact@vuna-africa.com
W: www.vuna-africa.com

Search for **Vuna Africa**