IDRC International Disaster and Risk Conference
August 25th to August 29th, 2008,
Davos, Switzerland

Feasibility of Risk Financing Schemes for Climate Adaptation

The case of Malawi

Hochrainer Stefan
International Institute for Applied System Analysis
Laxenburg, Austria

CA: Mechler, R., Pflug, G., Linnerooth-Bayer, J., Suarez, P.

Introduction: Malawi drought risk

- Food insecurity is chronic and greatly worsened by drought.

- The purpose of the Malawi pilot project was to enhance groundnut farmers' ability to manage drought risk and, in turn, access credit (Hess and Syroka, 2005).

- In 2005 nearly 1000 smallholder farmers in Malawi participated.

- Bundled loan and insurance contracts were designed to address issues associated with the risk of deficit rainfall during the growing season.

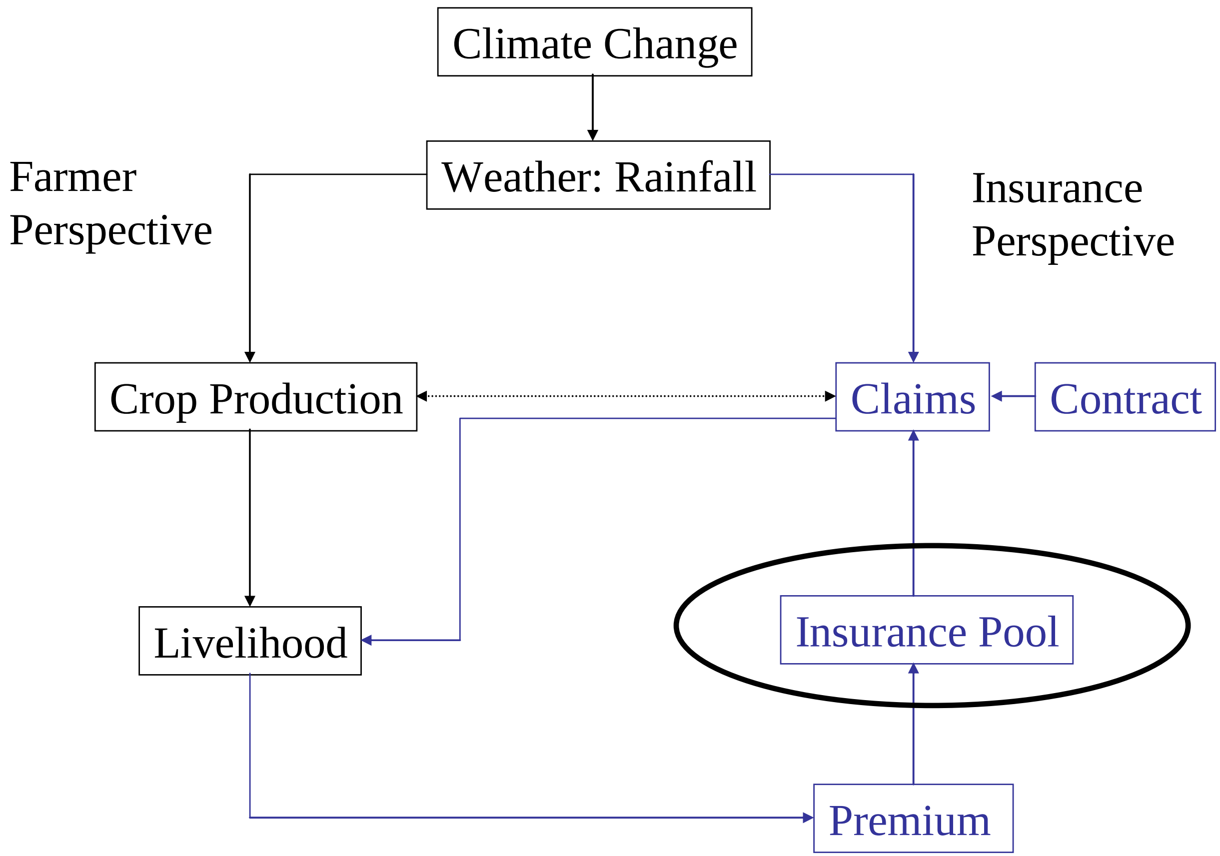
- Index-based weather insurance written against a physical trigger,

- Contracts were offered in four pilot areas: Nkhotakota, Kasungu, Lilongwe and Chitedze

Introduction

- Farmers participated in the pilot weather insurance project allowed to access an input loan package for better groundnut seed.
- Insurance mostly benefits to bank, yet farmers get access to highly-productive seeds
- Index-based systems appear most promising because of their low transaction costs
- Absence of moral hazard
- Basis risk, e.g. discrepancy between index and loss
- Climate change, e.g. increased weather variability and extremes

Introduction: Perspectives



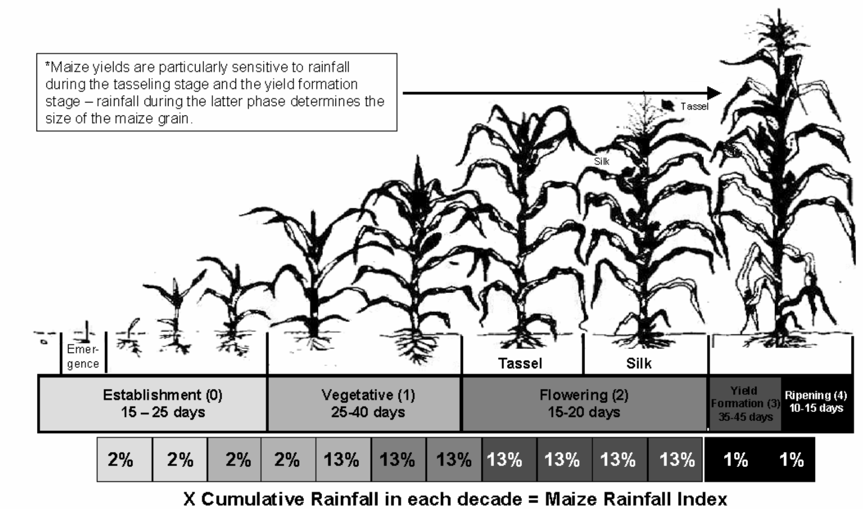
Index-based Insurance Contract Details

The insurance contract start date is dynamic. The sowing is expected to take place after 25 mm had fallen in a 10-day period within the 11 November to 20 January.

Three stages of crop development for the contract are defined:

- Initial (phase 1), 30 days
- Crop development (phase 2), 30 days
- Flowering (phase 3), 80 days

Each phase is subdivided into *dekads* of 10 days:

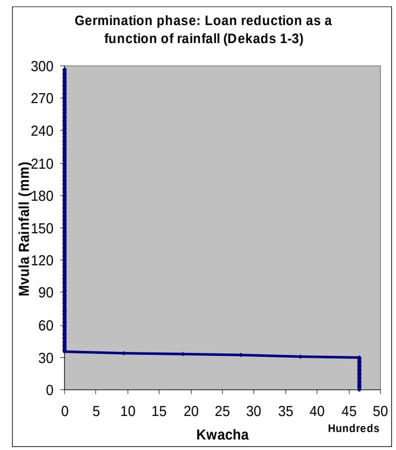


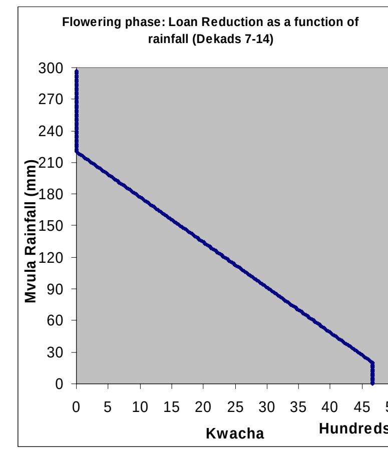
Index-based Insurance Contract Details

Trigger and claim payouts are based on the accumulated amount of rainfall for each of the three phases

	Upper trigger	Lower trigger
Phase 1	35 mm	30 mm
Phase 2	35 mm	30 mm
Phase 3	220 mm	20 mm

Upper and lower trigger for each phase

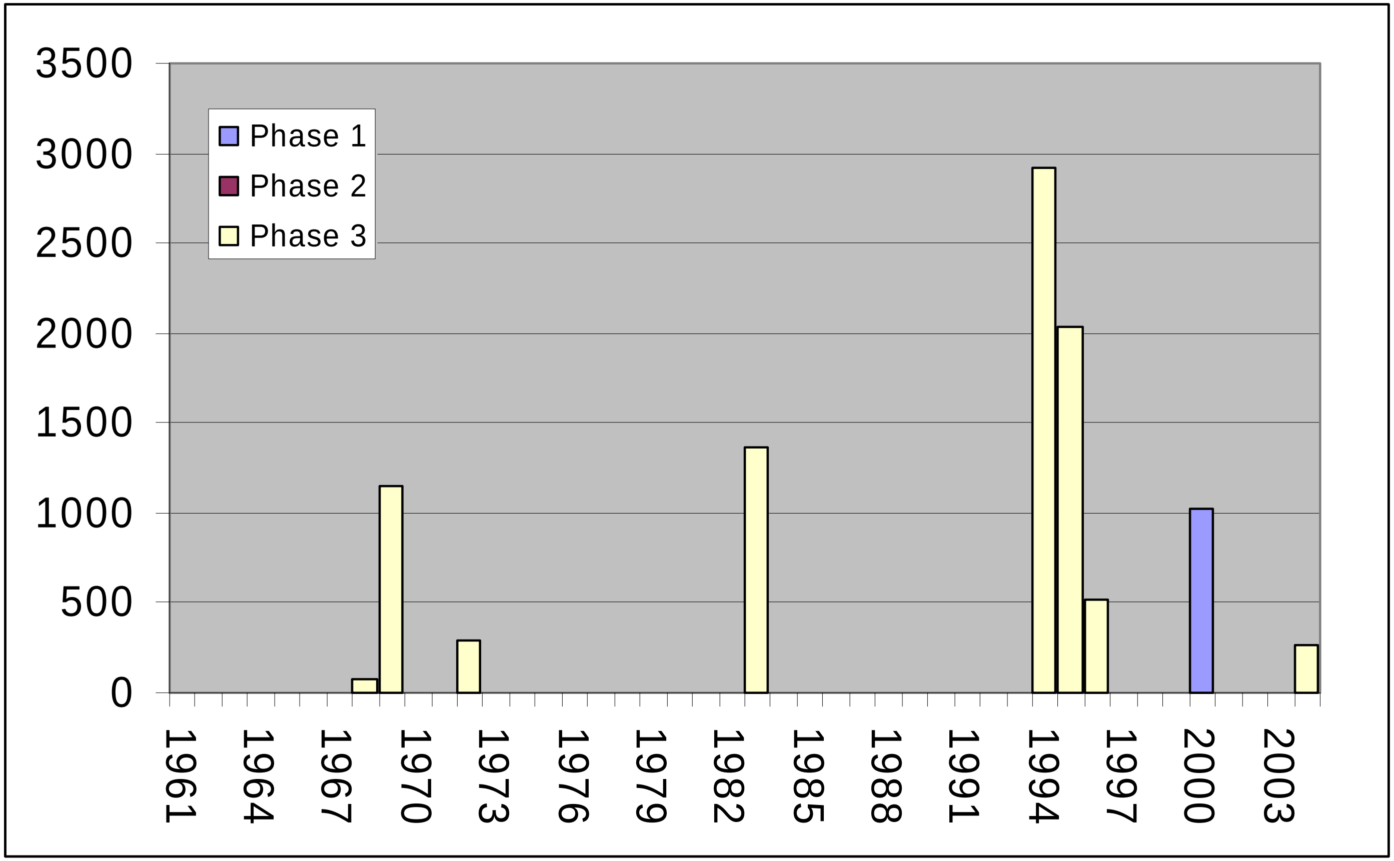




Thus, the contract can be seen like 2 contracts:

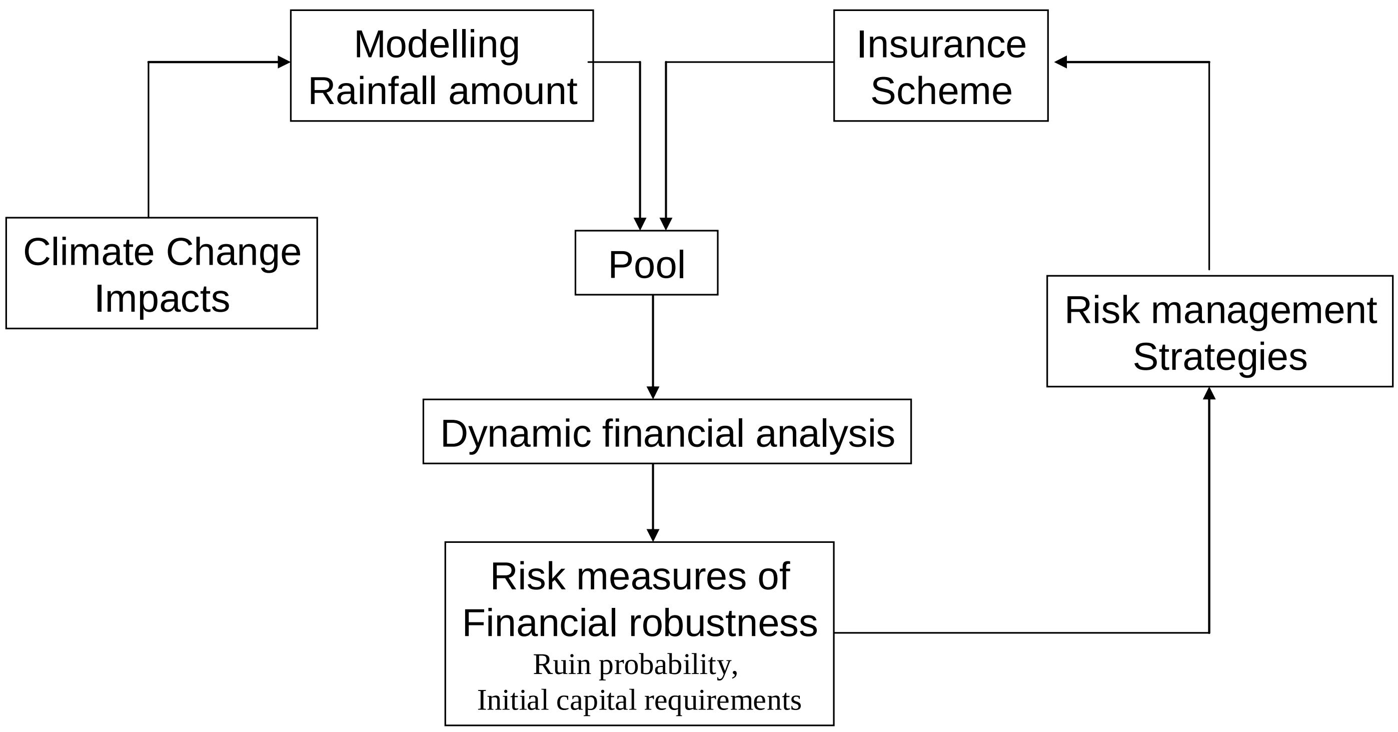
- **one for catastrophic events (first 2 phases)**
- **and one for more frequently less dramatic losses (third phase).**

Historical Payouts of Drought Insurance Contracts



Simulated payouts of drought insurance contracts from 1961 to 2005

Future Performance: Dynamic Financial Analysis

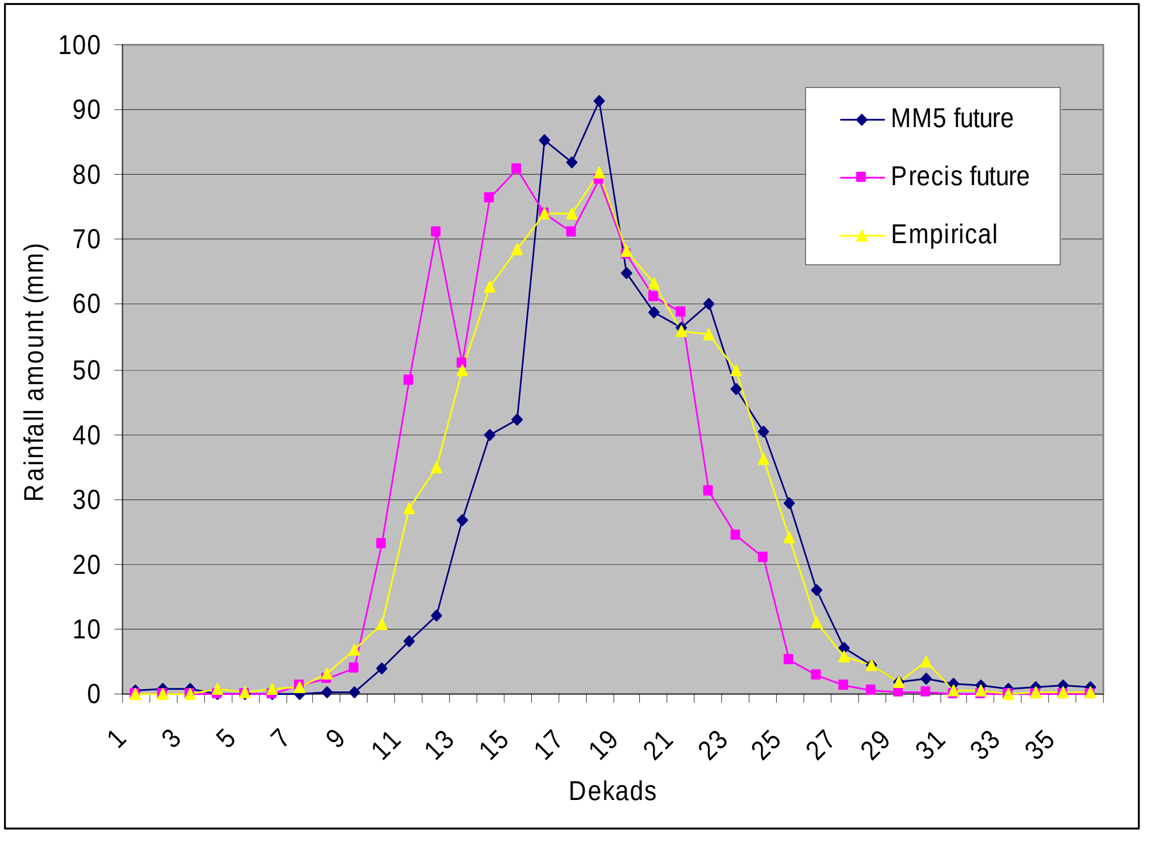


Input Data for the Rainfall Modeling

• Daily Rainfall amount from 1961 till 2005 from Chitedze station.
• PRECIS rescaled projections (monthly rainfall) of the control and future period. Control is January1960 to December 1979. Future is January 2070 to December 2089.
• MM5 rescaled projections (monthly rainfall) of the control and future period. Control is from January 1975 to December1984. Future is January 2070 to December 2079.

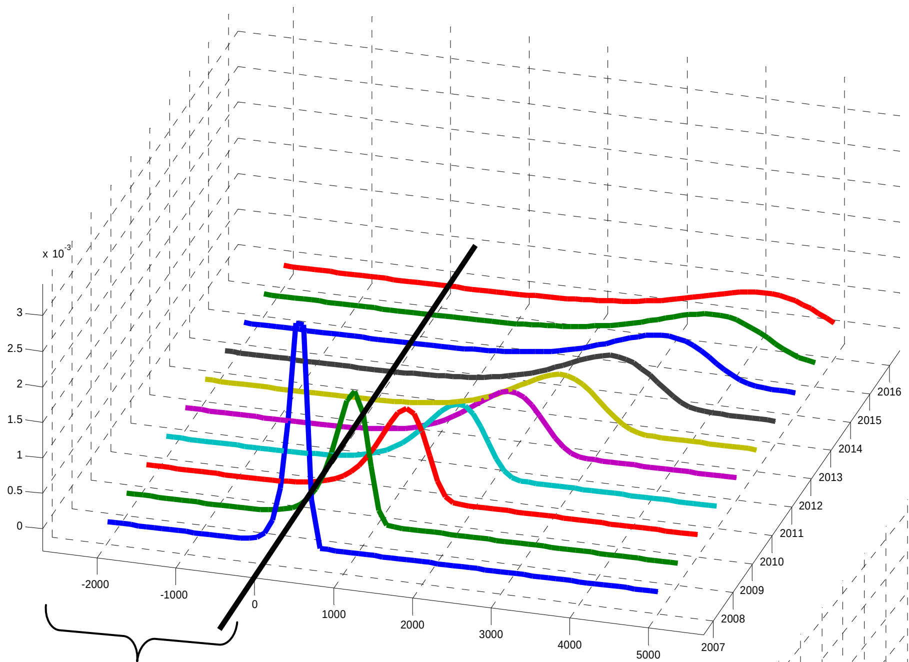
Rainfall: Past and Future projections

Quite different patterns for the two RCM's. Gamma distributions are fitted for each dekad and Model.



Mean accumulated rainfall per dekad for the empirical data as well as the MM5 and PRECIS Scenarios.

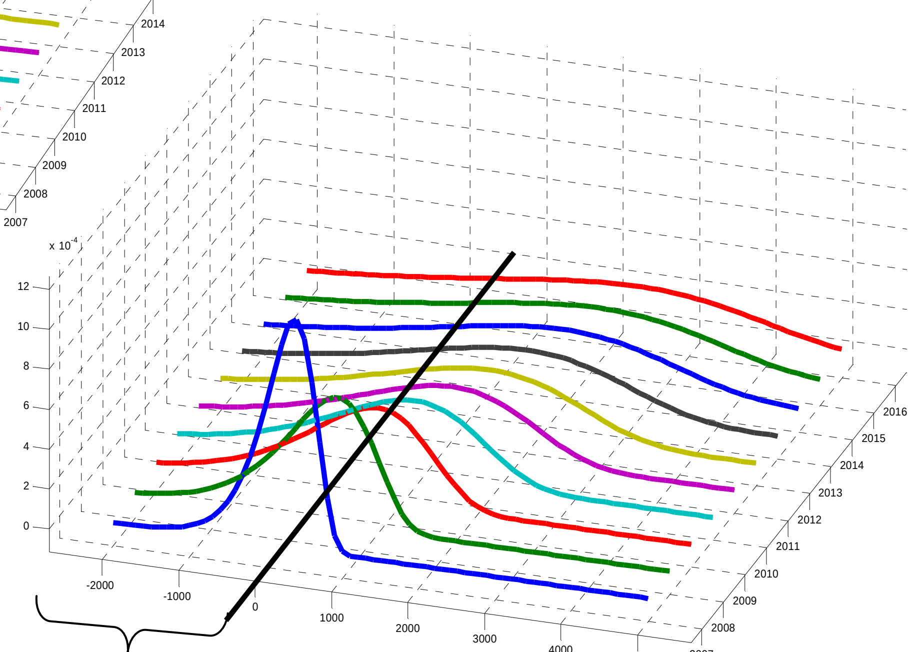
Dynamic Financial Analysis: Performance of the Pool



Ruin

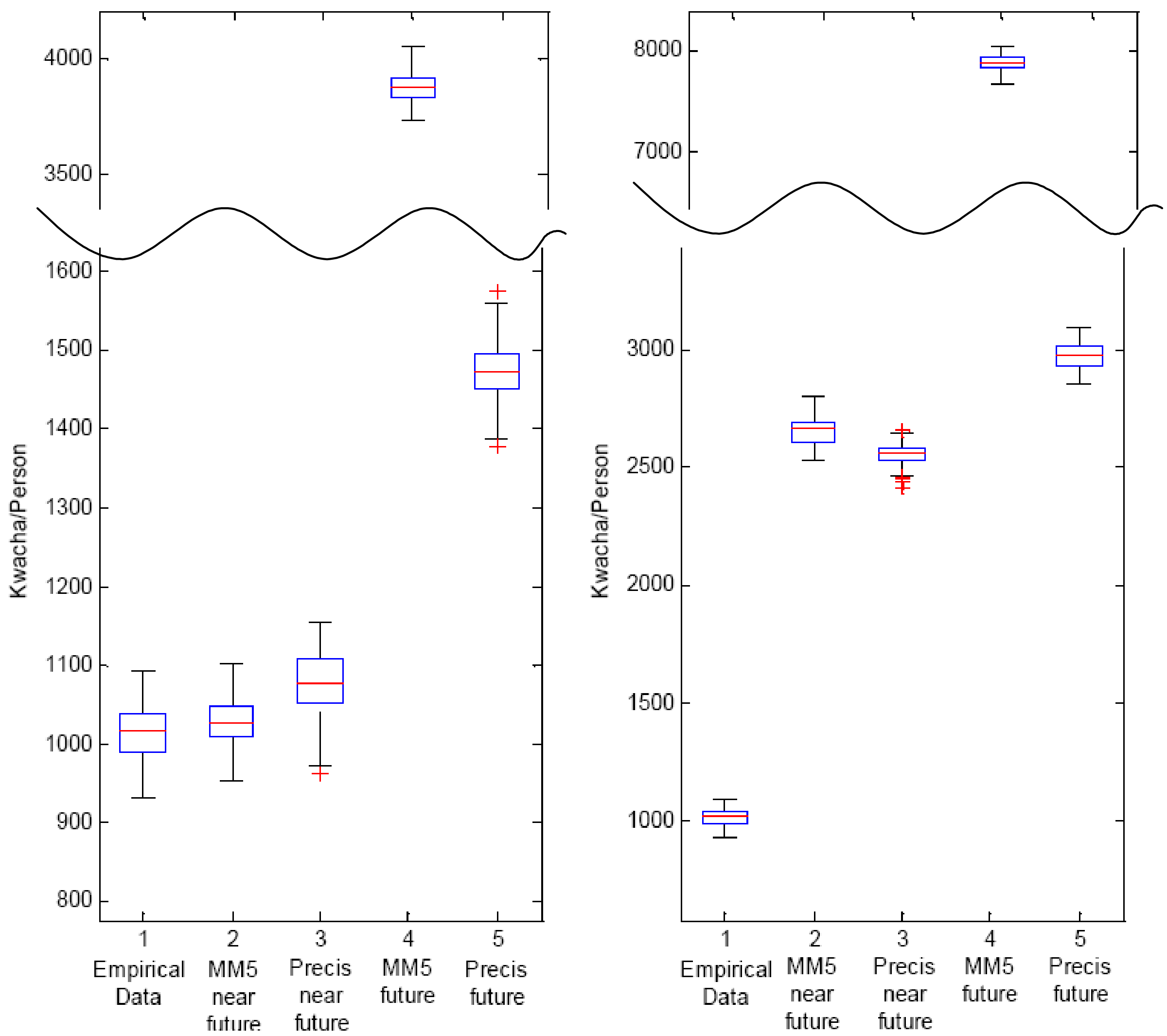
Current risk profile

Future risk profile
Heavy tails



Ruin

Backup capital needed to decrease ruin probability 5%



Additional Challenges

Including ENSO forecasts: Additional problems of adverse selection but also potential to increase productivity

Trust: trusting relationship of the farmers with organization imortant

	Trust the most (%)	Trust the least (%)
Rainfall measurements	1	27
Club members	12	3
NASFAM	46	30
Insurance company	10	11
Lending institution (OIBM or IFRC)	23	15

Communication process important, institutional trust is a pre-requisite for the sustainability of the scheme.

Basis risk has to be adressed

Farmer not insured against drought-induced food scarcity (livelihood insurance)

General Discussion

Insurance can smooth disaster shocks, but has the added benefit of helping high-risk agents escape the disaster-induced poverty traps by enabling productive investments.

Index-based systems appear most promising because of their low transaction costs and absence of moral hazard;

Malawi index-based insurance project would not be possible without outside technical assistance.

For the most part, current programs at all scales serve low-income and low-asset households, farms, and governments

Without exception, they receive support (technical assistance, product delivery, premium subsidy, reinsurance) from governments, donors, NGOs and financial institutions;

Private insurers with important role –often in partnership with NGOs – in underwriting risks, delivering the product and/or providing reinsurance;

General Discussion

Even if affordable, it is not clear if many current systems can operate, and scale up, without outside involvement.

This is due mainly to weak institutions, low insurance culture and limited ability to transfer and diversify risk;

Despite limitations, pilot programs are demonstrating their potential for protecting individuals and governments against weather shocks in many different contexts.

Role of Donors/Outside assistance/international role :

- **While donors should restrict their assistance to correcting market failures, donor-supported insurance systems are a legitimate route for addressing poverty and vulnerability, e.g. affordability, lack of insurance tradition and market, start-up costs, technical assistance**
- **Providing improved information, market institution and market infrastructure, reducing price of high layer risk, brokerin reinsurance deals, pooling insurance programs, e.g. tier 2 of the insurance pillar of MCII submission.**

End of Presentation

Additional Slides

Dynamic Financial Analysis

A dynamic financial analysis for a 10-year time period is performed to analyze the financial robustness of the contract under the different climate change settings.

Output variables include

(i) the probability of ruin of the insurance pool as a measure of its robustness and,

(ii) initial capital necessary to reduce the probability of ruin to 1% (5%) over 10 years.

In detail, the analysis assesses the financial robustness (risk of insolvency) of the Malawi scheme by estimating the scheme's capital accumulation and depletion accounting for stochastic shocks under dynamic climatic conditions.

To account for input uncertainty, two different RCMs are used. Uncertainty in terms of natural variability of the system is expressed with sensitivity analysis. Output uncertainty, e.g. uncertainty that derives from the modeling and simulation, is expressed using confidence intervals.

Introduction: RCM projections

Two different regional climate model projections which should represent the possible range of rainfall patterns in the future are used:

- **The PSU/NCAR mesoscale model (known as MM5) which is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation.**
- **Precis (Providing REgional Climates for Impacts Studies) which is based on the Hadley Centre's regional climate modelling system.**

Both regional climate models (RCM) are forced within the A2 emissions scenario global circulation model.

The main difference of the two RCM is that they simulate a hydrological cycle of different intensity. In Precis there is more rainfall with a lower than observed intensity, whereas in MM5 there is more rainfall with a higher than observed intensity.

Risk Management of the pool:

Two options to reduce the risk of insolvency to the insurance scheme are looked at:

- **Adjusting premiums and payouts,**
- **Increasing back-up capital, to decrease ruin probability to manageable levels.**

Only second option feasible because premiums are high already (6-10 % of insured value).

Simplified assumption: No back-up capital in initial year

The back-up capital necessary for the case without climate change ("empirical") serves as a baseline to which changes in back-up capital necessary are compared.

Mean and Variability Changes: Results

Probability of ruin for baseline, MM5 and PRECIS cases with mean and variability changes

Year\ Probability of ruin (%)	Baseline	MM5 future scenario	Precis future scenario	MM5 near future	Precis near future
2007	**0.0738**	**0.3789**	**0.2157**	0.1509	0.1492
2008	**0.1139**	**0.5607**	**0.3231**	0.2362	0.2332
2009	**0.1359**	**0.6621**	**0.3839**	0.2877	0.2832
2010	**0.1482**	**0.7254**	**0.4222**	0.3206	0.3149
2011	**0.1551**	**0.7694**	**0.4488**	0.3434	0.3368
2012	**0.1594**	**0.8019**	**0.4688**	0.3598	0.3522
2013	**0.1621**	**0.8270**	**0.4839**	0.3725	0.3639
2014	**0.1639**	**0.8469**	**0.4962**	0.3826	0.3730
2015	**0.1652**	**0.8633**	**0.5060**	0.3908	0.3804
2016	**0.1660**	**0.8769**	**0.5141**	0.3977	0.3864

Conclusion

According to this analysis, climate-change induced stress will likely decrease the financial robustness of the Malawian insurance pool in the 10-year period between 2006-2016.

With predicted stronger changes in rainfall patterns, climate change will likely have more dramatic negative effects in the 10-year period, 2070-2080.

Uncertainty was handled in various ways:
Input uncertainty, such as associated with rainfall projections, was dealt by using different RCM models.
Uncertainty in terms of natural variability of the system is expressed with sensitivity analysis.
Output uncertainty, e.g. uncertainty that derives from the modeling and simulation, is expressed using confidence intervals

Assuming that premiums are not raised from current levels, additional back-up capital would be necessary to render the Malawi program robust at the 95% and 99% confidence levels, for all situations.

Remaining Problems

There are various important issues which were taking not into account:

Uncertainty related to future states of the world and associated greenhouse gas emissions and temperature rise as represented by the SRES scenarios are not incorporated

A major limitation arises since SRES scenarios do not have associated probabilities.

Data availability on rainfall greatly limits future projections, especially estimating future rainfall variability, which is a key factor influencing crop yields.

Additional computer runs of the RCMs models would improve capacity for forecasting rainfall variability.

Remaining Problems

This analysis has also not considered inter-annually correlated rainfall and drought patterns, e.g. due to the El Nino effects.
Seasonal changes would negatively affect the insurance pool

Because of the complexity of the biological process of crop growth and changing rainfall patterns, trigger events are not changed over time, an assumption that is not valid with climate change.

The analysis do not consider possibilities of planting new crop types which behave better under new climate scenarios.

Finally, this supply-side analysis did not consider basis risk to the farmers.

Achievements

The importance of this analysis goes beyond its implications for the Malawian insurance scheme.

By combining catastrophe insurance modeling with climate modeling, the methodology demonstrates the feasibility, albeit with large uncertainties, of estimating the effects of climate change on the near- and long-term future of micro insurance schemes serving the poor.

By providing a model-based estimate of the incremental role of climate change, along with the associated uncertainties, this methodology can quantitatively demonstrate the need for financial assistance to protect insurance pools against climate-change induced insolvency.

Overview Malawi Scheme

Provider (country, year of inception of disaster insurance)	NASFAM with banks OIBM and MRFC, and insurer IAM (Malawi, 2005)
Delivery model	Partner–agent, group-based: Weather Crop Insurance priced into loan offered to farmers, bank thus is insured and receives claim in case of event.
Premium	6–10% of insured assets as mark-up interest on loan
Cover	Outstanding loan with bank paid by insurer
Clients	Ca. 900 (2005), 1000 (2006)
Reinsurance	No
Assistance	World Bank with technical assistance, catalyzing function
Major event experienced?	No, some payouts in 2005/06 season
Outlook	Should lead to higher yield–higher risk activities but no evidence yet; premiums substantial. Concept of insurance not well understood among large number of clients

Sources: Hess and Syroka, 2005; Mapfumo, 2006; Suarez, 2006.