

“Session 3 - Innovations in Management of Agricultural and Weather Data”

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*Congrès International
sur l'assurance et la
réassurance des
risques agricoles*

*Marrakech,
MAROC*

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Agriculture Global Specialty

Global Hubs

- World's biggest crop Reinsurance Broker (70% of World's market)
 - The most diversified client base in crop Reinsurance
 - **More than 2 Billion USD** of ceded Reinsurance premiums
- GC is the biggest source of Crop insurance premium for almost all Reinsurers

APAC

EMEA

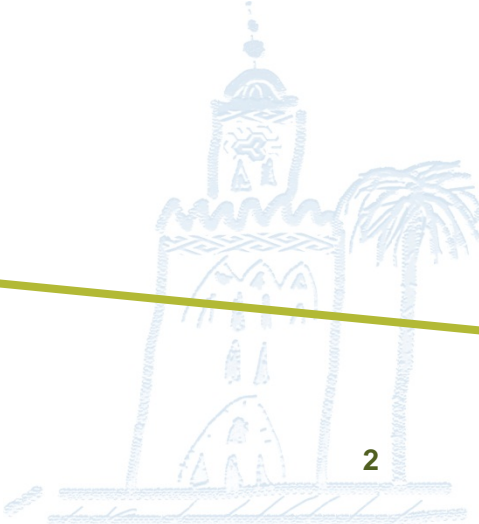
LATAM

Canada

U.S.

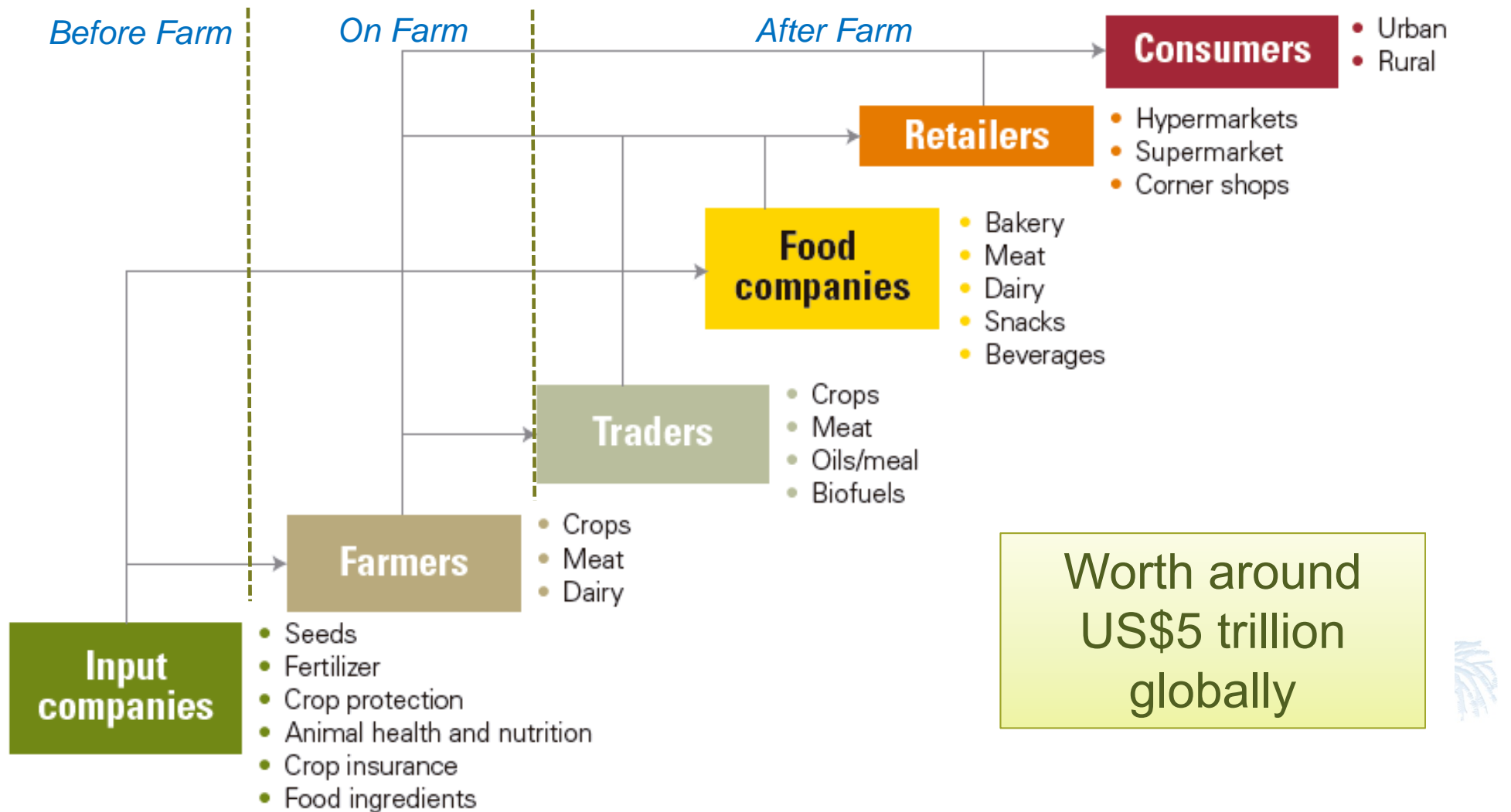
Sydney

INTRODUCTION



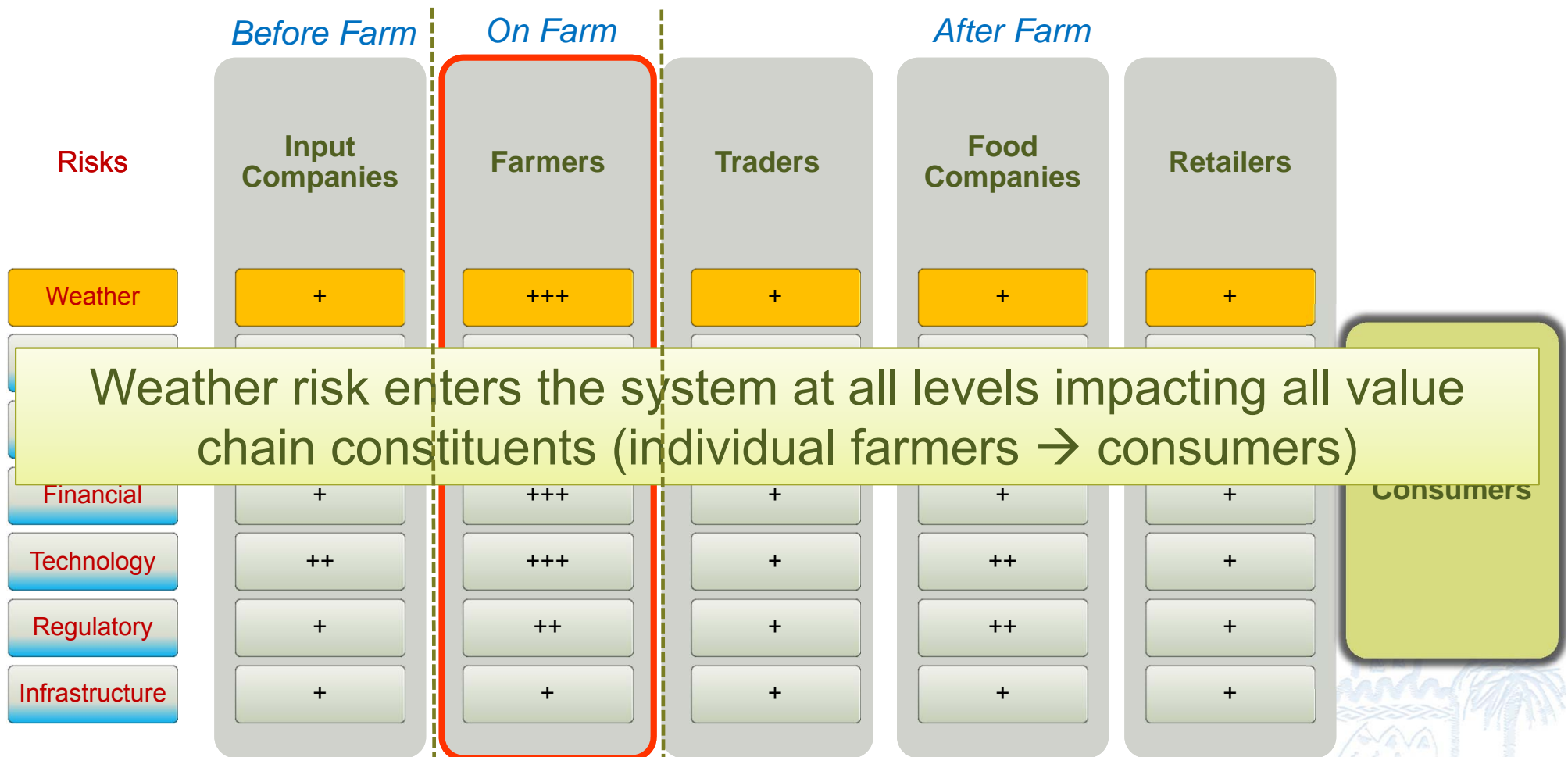
Agribusiness Production Value Chain

The players:



Agribusiness Production Value Chain

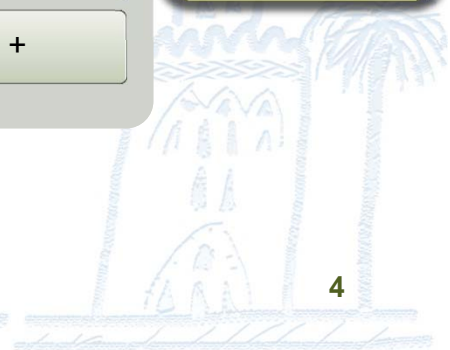
Main Perils Associated with agro production



+++: High level impact
 ++: Medium Level Impact
 +: Low level impact

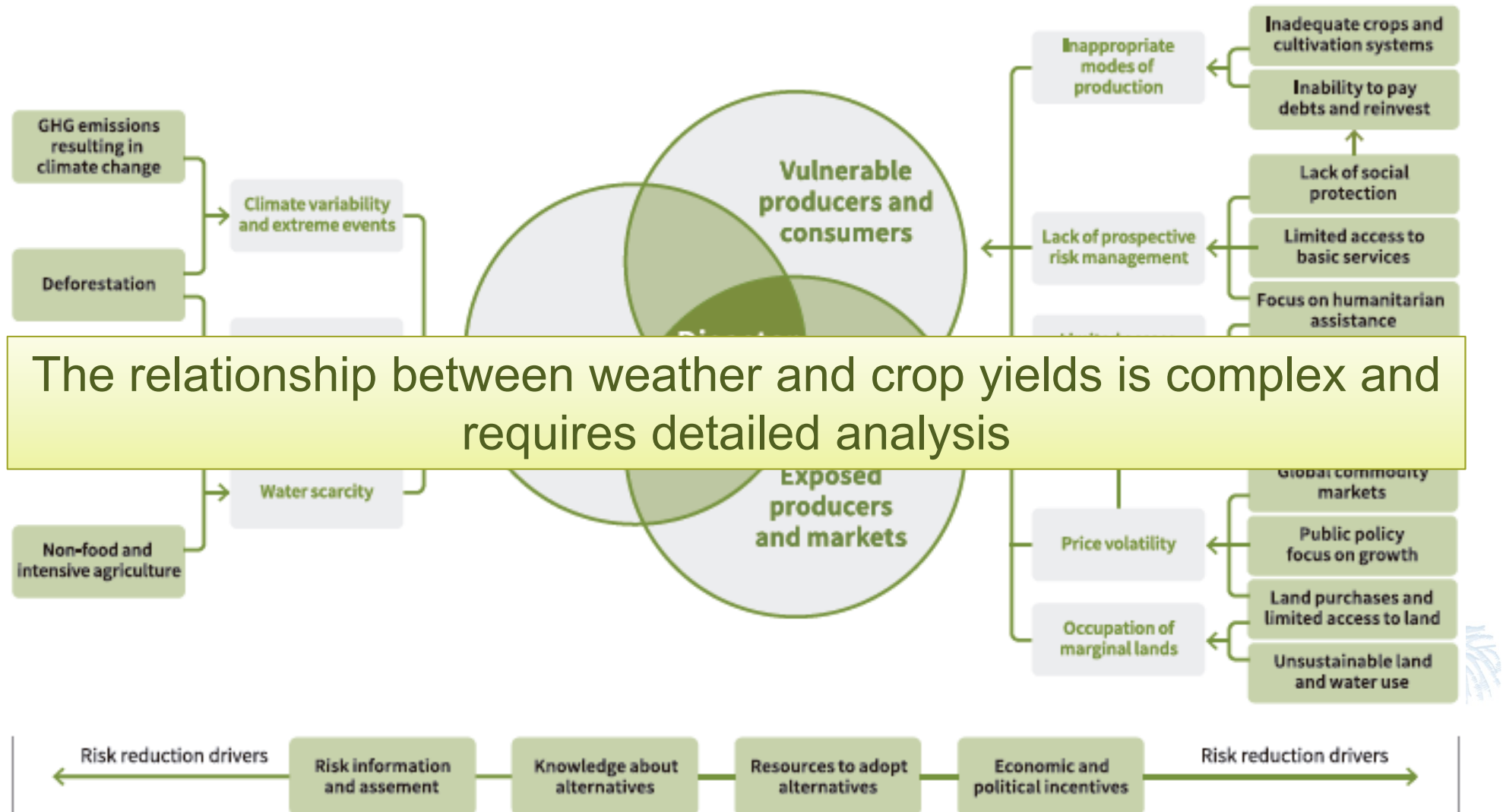
GUY CARPENTER

*Source: Guy Carpenter and adaption from "Partnering for Food Security in Emerging Markets", Swiss Re, 2013.



Many Dimensions of Disaster Risk in Agriculture

Identifying and Quantifying Impacts



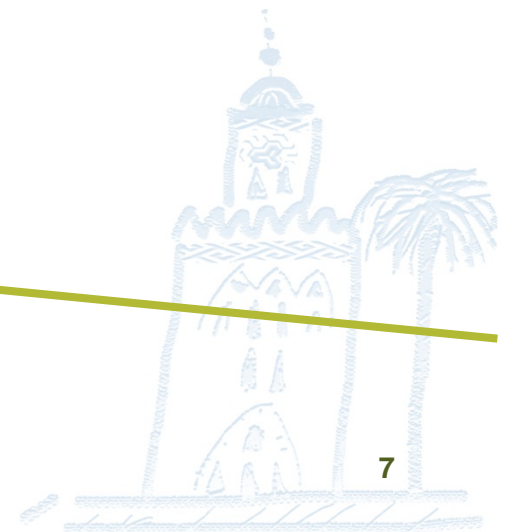
Example: resilience mechanism for farmers

Various alternatives



AGRICULTURAL INSURANCE/REINSURANCE

CONTEXTUALIZATION



Agricultural Insurance/Reinsurance

Advantages of Agricultural Insurance/Reinsurance as a Farm Management Strategy and Risk transfer mechanism

Decreased impact of natural hazards

Disposal of funds to overcome losses

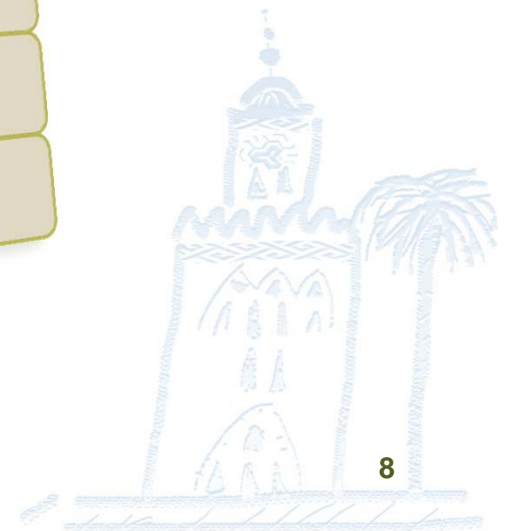
Increased credit disposal; collateral nature of insurance

Less *ex-post* compensations

Increased risk management awareness

Sustainable agriculture encouragement

Safety net for poorer economies

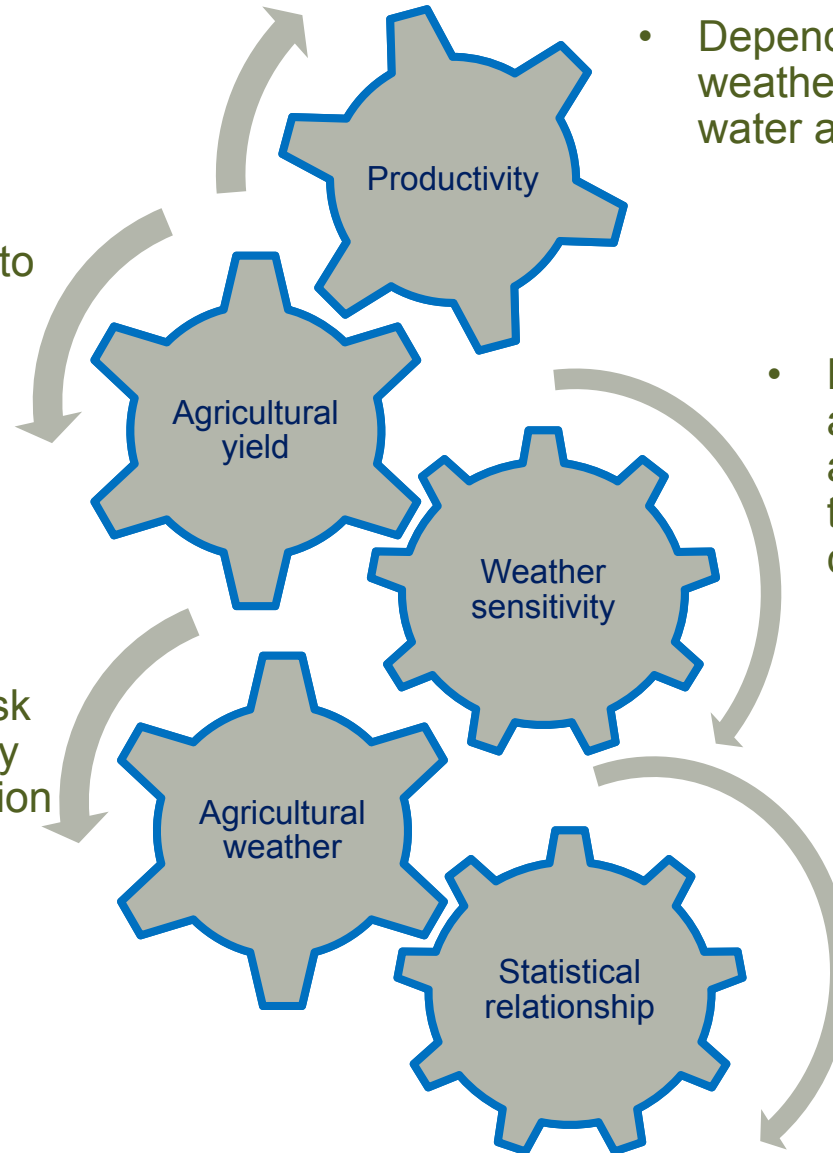


Agriculture and Weather Risk

An Important (though complicated) Relationship

- Indices of crop available water are most often used to represent changes.

- Agricultural weather risk needs to be individually assessed for each region and crop



- Depends strongly on changes in weather, particularly on changes in water availability

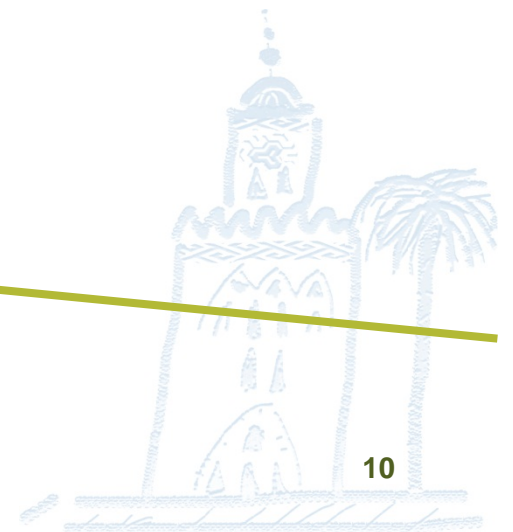
- Depends on the crop as well as the local weather regime and other variables (e.g. terrain, land use, climate change, etc.)

- Its development is challenged by the dual complexity of the agricultural sector and the climate...



AGRICULTURAL INSURANCE/REINSURANCE

TRADITION & INNOVATION



Types of Agricultural Insurance/Reinsurance

Pros and Cons

Parametric / Index-Based



Traditional

Yield

Characteristics

- Area-yield data trigger
- Multiperil coverage

Pros

- Comprehensive protection

Cons

- Data reliability issues
- Slow data provision

Margin

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Innovative Agricultural Insurance Products

PRODUCTS

- **Livestock First (LF)**
Timely, index-based margin insurance product for livestock producers.
- **Crop First (CF)**
Innovative, index-based margin insurance product for crop producers.
- **Weather First (WF)**
Unique, index-based weather insurance product for crop and livestock producers.

Agriculture First
Index-Based Insurance

Agriculture First (AF) is a platform of innovative index-based agricultural insurance products developed and owned by two University Professors – Dr. Milton Boyd and Dr. Lysa Porth.

The suite of products offers the following key features:

- Unique web-based delivery platform capability that is easy to navigate, with cost efficient administration, and low sales costs.
- Reliable indexes or reference prices.
- No moral hazard or adverse selection risk.
- Fast and easy application and claims settlement processes.

- BASIS RISK
- New Concept

Weather

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Innovative Agricultural Insurance Products

Agriculture First
Index-Based Insurance

- **Livestock First (LF)**
 - Index-based margin insurance product for livestock producers.
 - LF is more than price insurance, and provides more protection.
 - LF protects against narrowing margins for livestock producers, when livestock prices drop and/or feed grain prices rise.
 - Index is based on livestock and feed prices that reflect local market conditions, and prices that are transparent and publicly observable.
 - Major livestock target markets include hogs, cattle, sheep, goats, poultry, dairy, and aquaculture.
- **Crop First (CF)**
 - Innovative index-based margin insurance product for crop producers.
 - CF is a differentiated product that is more than price insurance, and provides more protection.
 - CF protects against narrowing margins for crop producers, when crop prices drop and/or production costs increase such as fertilizer, seed, fuel, herbicides/pesticides, and labor.
 - Index is based on crop and input prices that reflect local market conditions, and prices that are transparent and publicly observable.
 - Major crop target markets include rice, wheat, canola (rapeseed), corn, soybeans, etc.
- **Weather First (WF)**
 - Innovative index-based weather insurance product for crop and livestock producers.
 - Differentiated product from existing weather insurance products that is index-based and uses a combination of land-based weather stations and satellite weather data to help overcome limitations of existing weather insurance products and potential basis risk.
 - Index is based primarily on temperature and precipitation, or uniquely, a combination of the two.
 - Designed for crop and livestock producers:
 - Weather insurance for use for various crops, where excess heat or cold, or excess or insufficient rainfall causes crop damage or failure. Excess wind may also be considered e.g. monsoon areas, and trees, tropical crops.
 - Weather insurance for livestock if drought and heat are perils. For example, if there is drought, there is less water available for livestock, so lower meat weight gain, or animal death. Or, if there is excess heat, then lower meat weight gain or animal death.

micro level

Indemnity

Characteristics

- Individual client loss assessment
- Multiperil coverage

Pros

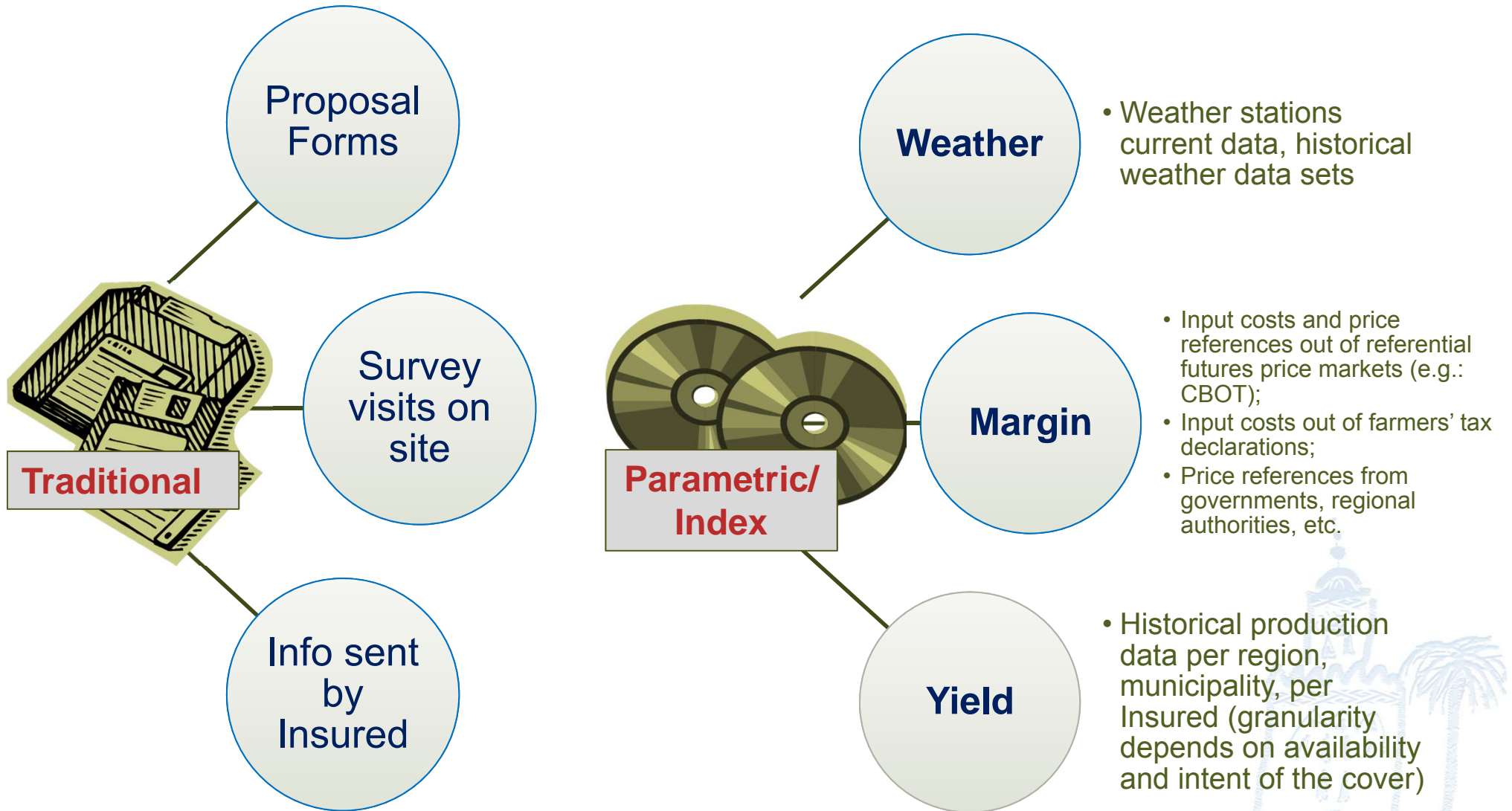
- Comprehensive protection

Cons

- Expensive to administer
- Time consuming loss assessment

Types of Agricultural Insurance/Reinsurance

Hazard Data Collection Differences



INDEX INSURANCE BASICS



Index-Based Agricultural Insurance

Characteristics of a Good Index

1

- Observable and easily measured/computed

2

- Objective

3

- Transparent

4

- Independently verifiable

5

- Can be reported in a timely manner

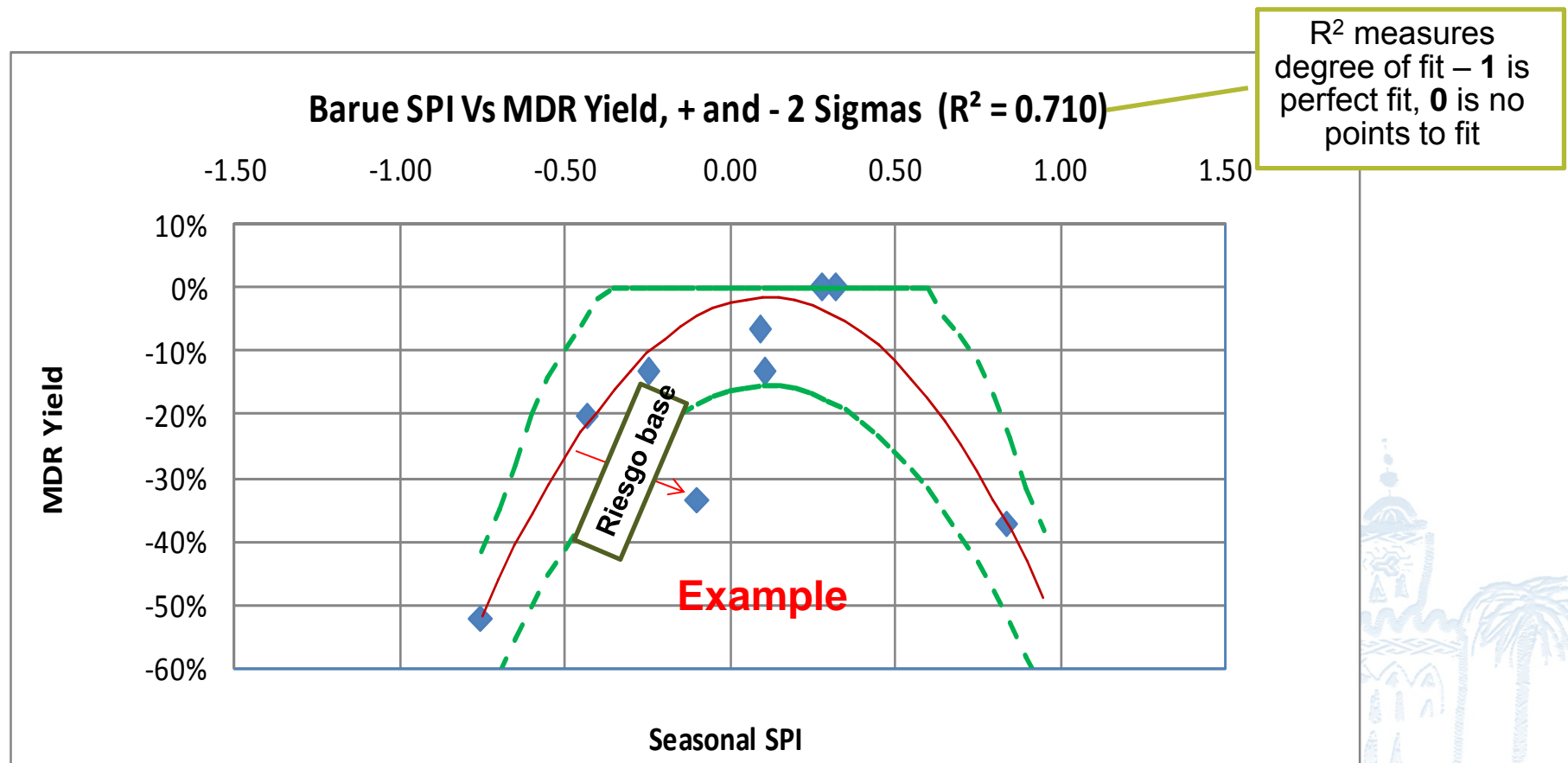
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- Stable over time



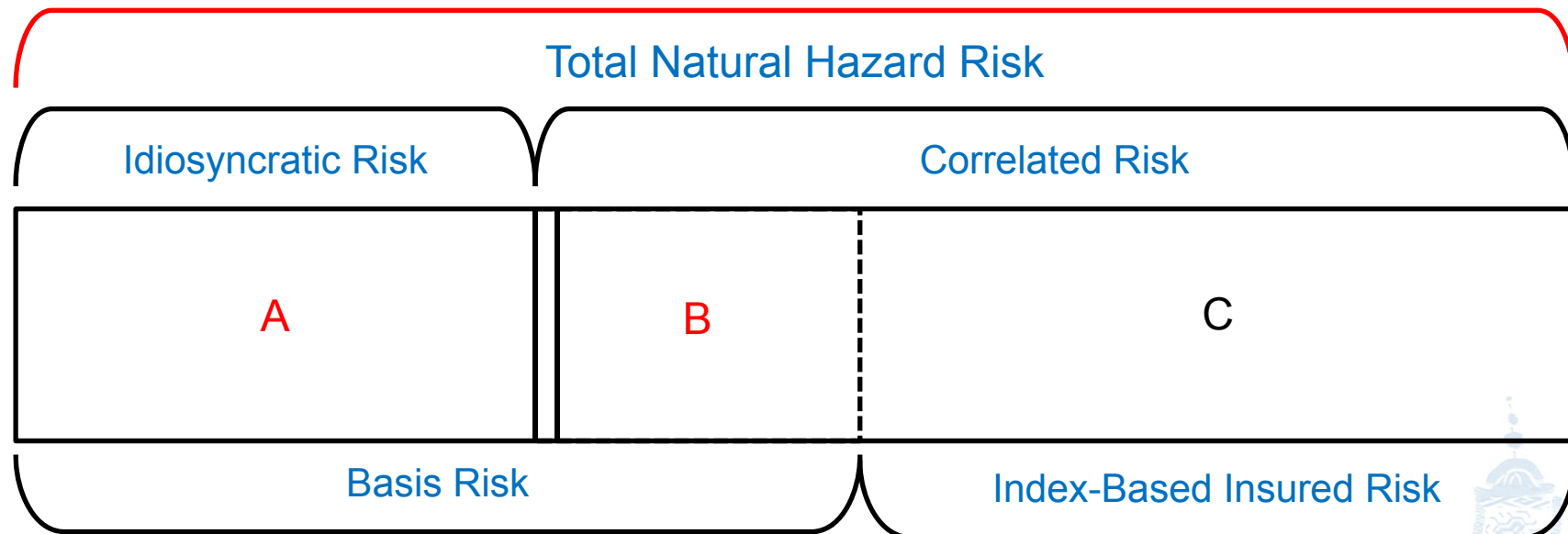
Structuring a Weather Index Product

- **Correlation:** the quality of a weather index is generally defined by the strength of correlation between the index and agriculture outcomes



Structuring a Weather Index Product

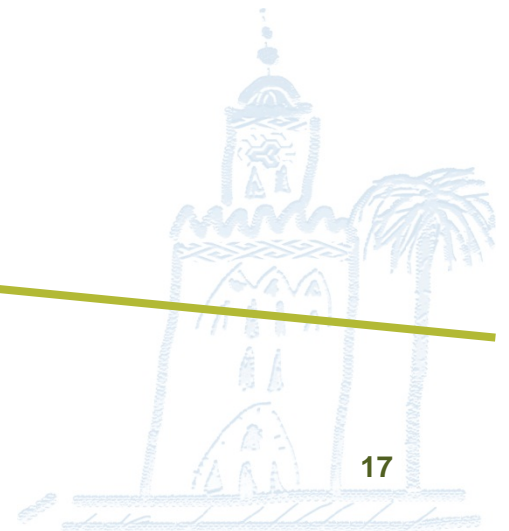
- **Basis Risk:** imperfect correlation between the insured's loss experience and the underlying weather index on which payout is based - e.g. agricultural loss occurs, but index is not triggered (or **vice-versa**)



- Communities and institutions can typically manage basis risk type 'A' through reserves or *ex post* financing
- Basis risk type 'B' is more difficult to manage

TECHNICAL CONSIDERATIONS

HAZARD DATA



Hazard Data Sources

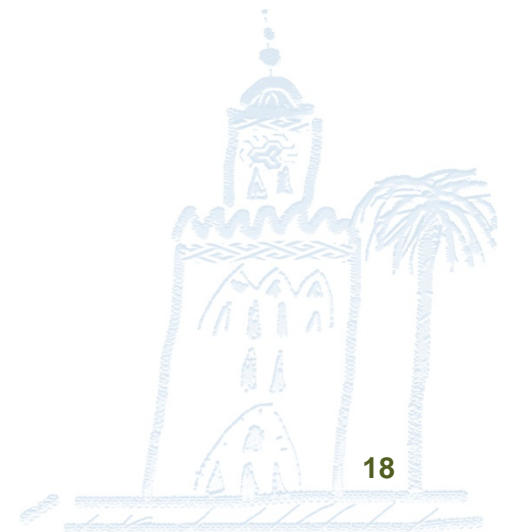
Important Qualities for Index Design

Sources of meteorological data:

- **Weather Stations**
- **Satellites**
- **Reanalysed**

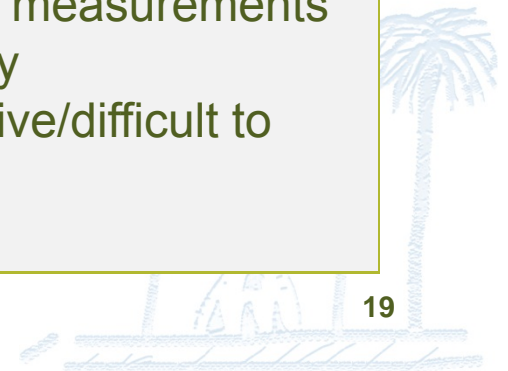
The most important factors of hazard data for index design include:

- **Duration:** 20+ years ideal
- **Availability:** Updated periodically (e.g. daily) and free/low-cost
- **Consistency:** Data is of similar quality throughout; no significant gaps in historical record



Pros and Cons of Data Sources

	Weather Station Data	Reanalysed Data	Satellite Data
+	<ul style="list-style-type: none"> ▪ Direct measurements ▪ Possibly long time series (>50 years) ▪ Mostly free or very cheap 	<ul style="list-style-type: none"> ▪ Fills temporal/spatial gaps in station data ▪ Tend to cover a long period of time at relatively high resolution ▪ Can be used to generate simulated rainfall to estimate long term risk 	<ul style="list-style-type: none"> ▪ Globally complete ▪ ~15 years without missing values ▪ Constant quality ▪ Usually open source
-	<ul style="list-style-type: none"> ▪ Quality (missing values, heterogeneous measurements) ▪ Short records ▪ Distance from farmer (spatial basis risk) 	<ul style="list-style-type: none"> ▪ Often contain major assumptions ▪ Datasets are frozen in time and generally not updated with real time recordings 	<ul style="list-style-type: none"> ▪ Coarse resolution ▪ Indirect measurements ▪ Possibly expensive/difficult to access

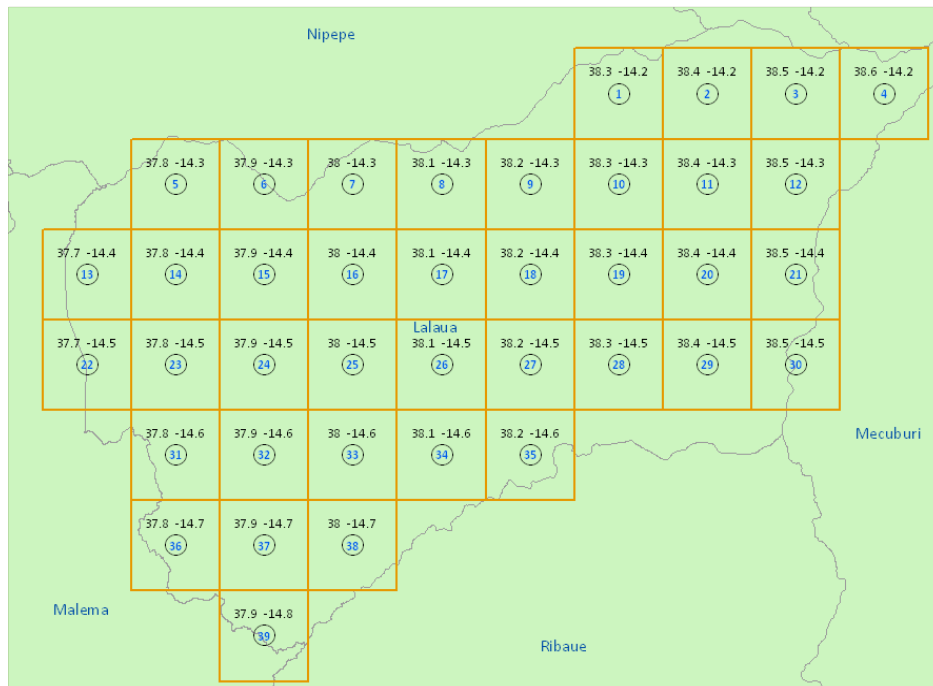


Example of Grid data measurements for IAM WII Cotton Pilot - Mozambique

Remote Sensed Measurement Details – Lalaua

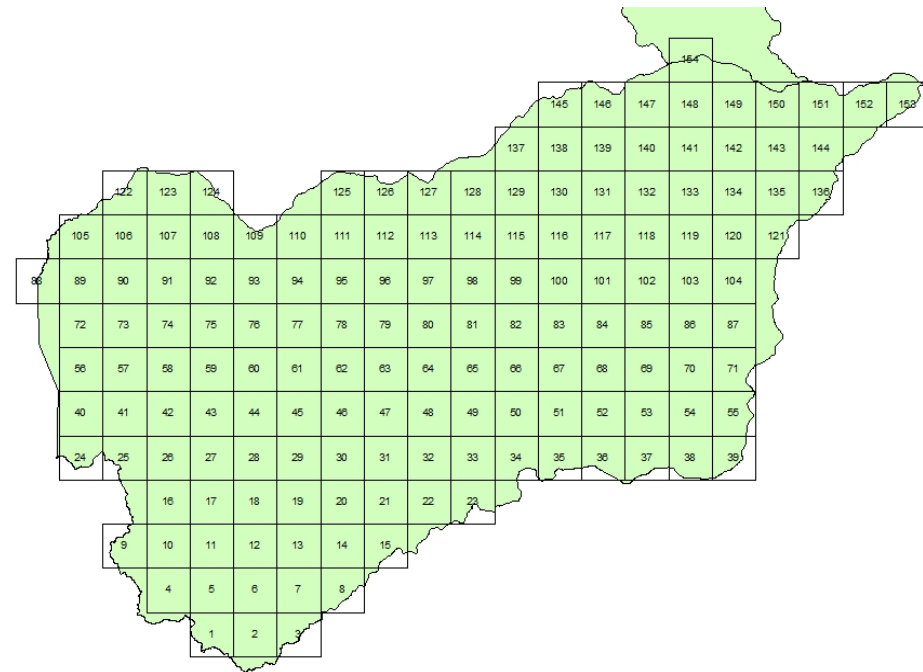
Rainfall

- GeoWRSI
- 39 grid cells (10km²)

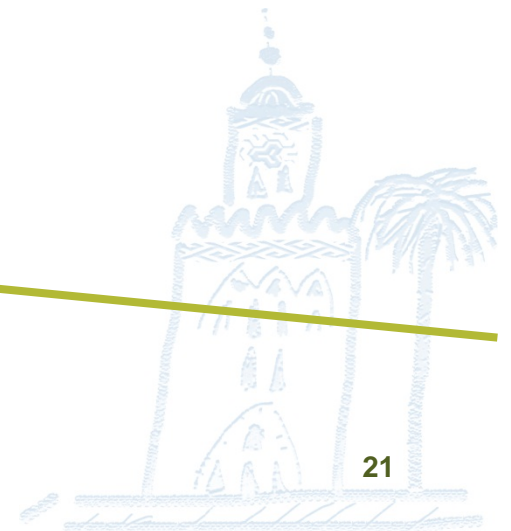


Temperature

- MAIRS 8-day
- 154 grid cells (5.6km²)



TECHNICAL CONSIDERATIONS SELECT INDEX OPTIONS

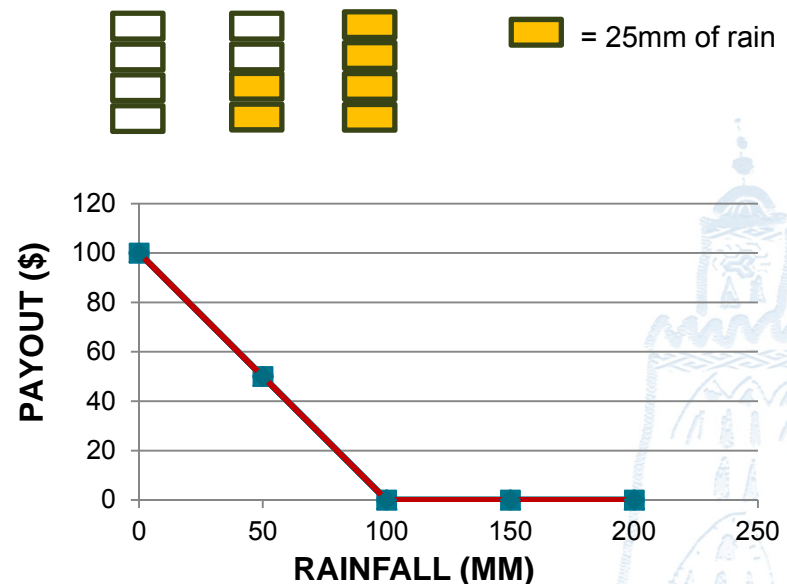


Rainfall Index Options

- **Pure Precipitation Index**

- Simple measurement of rainfall incidence
- Works best when subject crops are purely rainfed
- If pure rainfall correlates reasonably well with crop yield (or crop yield info is unavailable) then rationale for additional index complexity is diminished

Example: Payout linearly interpolated between 100 mm and 0 mm of rainfall



Rainfall Index Options

- **SPI -Standard Precipitation Index**

- A measure of the deviation from average historical rainfall
- Temporal & Spatial flexibility: can reliably be estimated within any time period or geography
- Works best with 20+ years of precipitation data

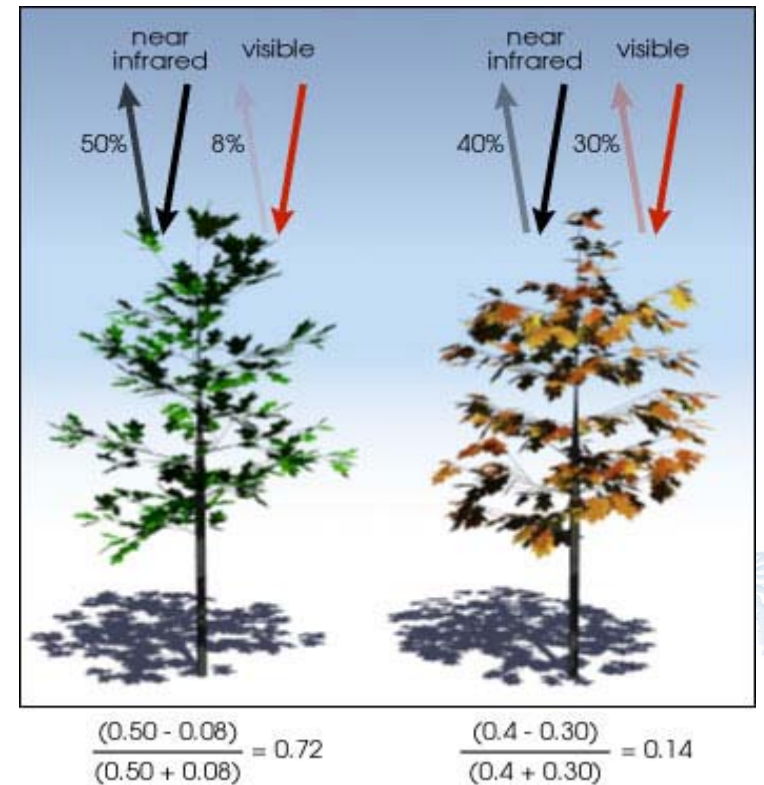
***Example:** a 1-month SPI at the end of November compares the 1-month precipitation total for November in that particular year with the November precipitation totals of all the past years on record*

SPI Values	
2.0+	extremely wet
1.5 to 1.99	very wet
1.0 to 1.49	moderately wet
-.99 to .99	near normal
-1.0 to -1.49	moderately dry
-1.5 to -1.99	severely dry
-2 and less	extremely dry

Rainfall Index Options

- **NDVI – Normalized Difference Vegetation Index**
 - Ratio of the visible and near-infrared light reflected by vegetation

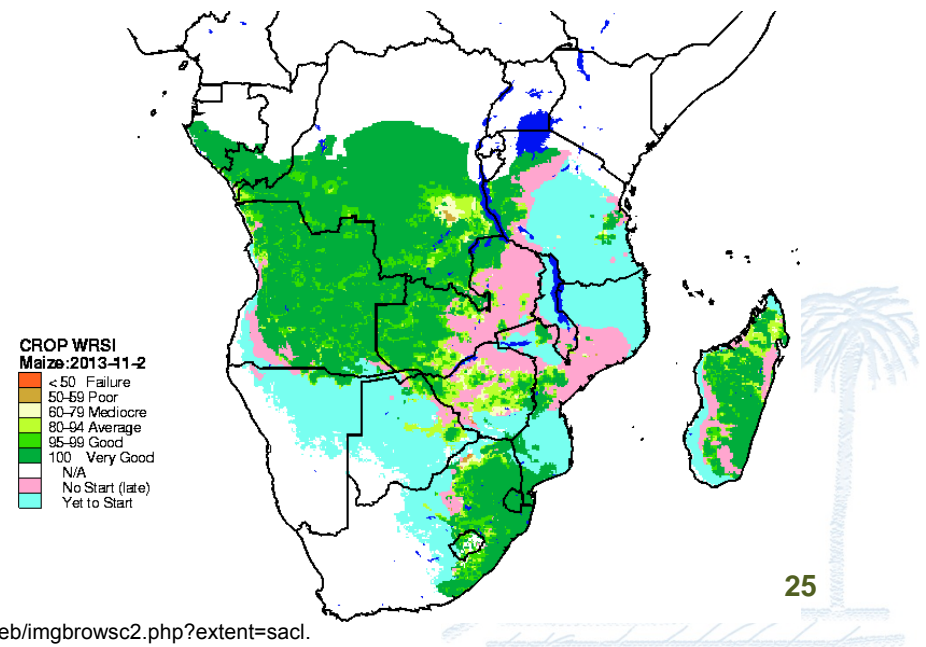
Healthy vegetation (left) absorbs most of the visible light that hits it, and reflects a large portion of the near-infrared light. Unhealthy or sparse vegetation (right) reflects more visible light and less near-infrared light



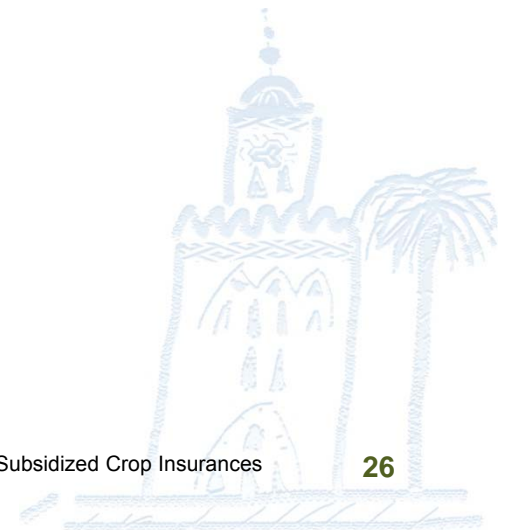
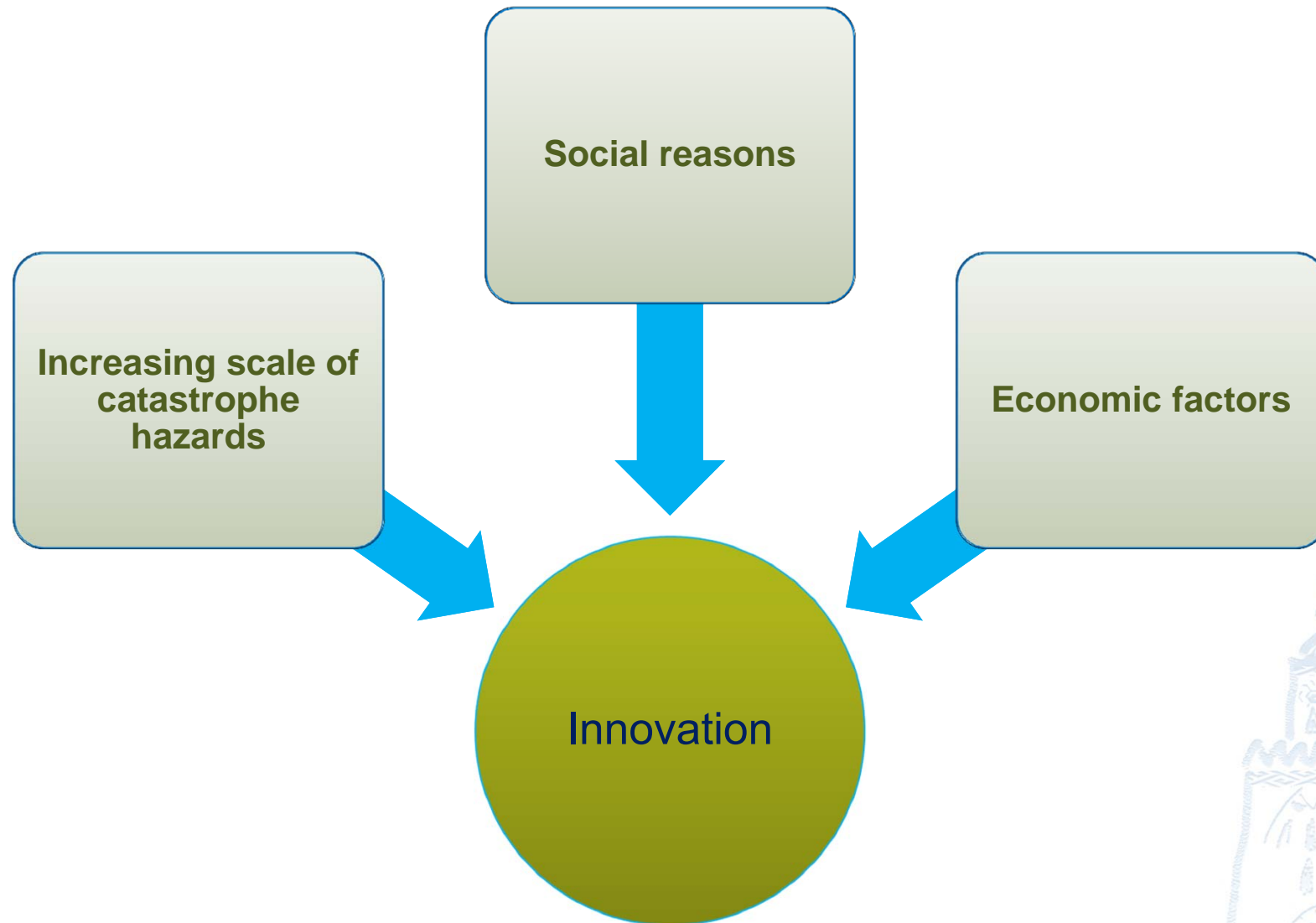
Rainfall Index Options

- **WRSI – Water Requirement Satisfaction Index**
 - Ratio of Actual Evapotranspiration to Potential (AET/PET)
 - An indicator of crop performance based on the availability of water to the crop during a growing season
 - The most important inputs to the model are precipitation and potential evapotranspiration (PET)

FEWS NET Current WRSI output shown for Maize, 2nd Dekad of November, 2013 →



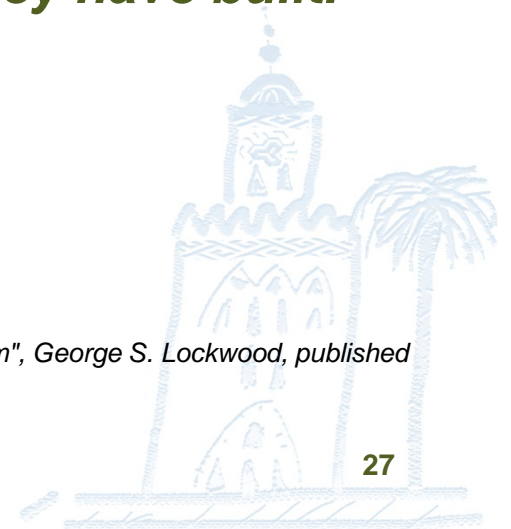
Innovation! Why Index Insurances???



A reflection on innovation...

“The disrupters will likely capture greater value for their superior products. They will replace the current generation of incrementalists, who have strong vested interests in continuing to perfect their present technologies and business models at the facilities they have built.”

Source: Adapted from "Where is aquaculture Headed? Competition, Consolidation may yield new production paradigm", George S. Lockwood, published on GAA magazine, issue January/February 2013, page 52.



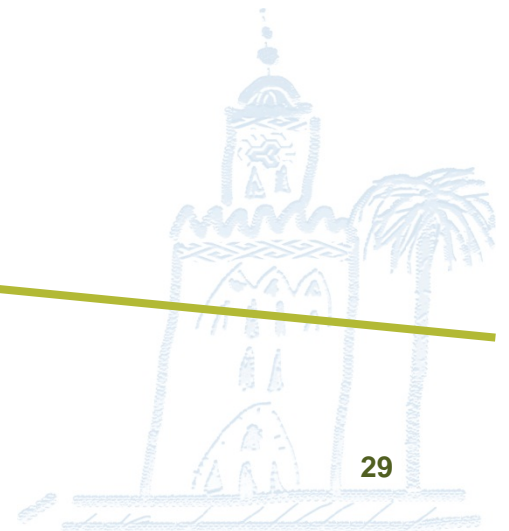
Merci pour Votre Attention!!



GUY CARPENTER

شكرا على اهتمامكم

APPENDICES



Traditional Agriculture Insurance

Overview of Coverage Elements

Element	Options
Sum Insured	Cost of production or income per unit planted/area
Covers	Sowing, standing and post harvest risk
Perils	All Risks subject to exclusions
Exclusions	War and Terrorism, Avoidable risks
Indemnity/Payout	Based on deviation from stated yields
Triggers/Thresholds	Typically define major deviations from average yields – shortfall greater than 10 to 40% of average yields
Settlement	Based on field measurements of yield and/or estimation based on remote sensing technologies
Resolution	Individual Farm → State-level

Traditional Agriculture Insurance

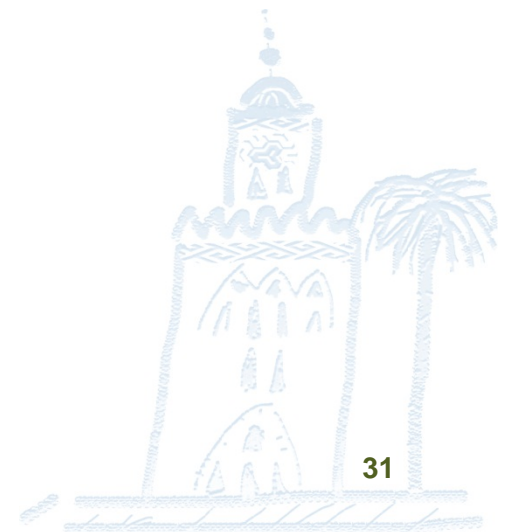
Advantages and Disadvantages

Advantages

- Minimum basis risk at area level
- Practically all risks covered
- Payout is a function of actual yield
- Relatively easy to design with adequate yield data

Disadvantages

- Potential for large moral hazard
- Limited historical data on crop yield
- Definition of 'normal' yield against which payout is assessed
- Potential high administrative costs
- Potential delays in claim settlements



Index-Based Agriculture Insurance

Overview of Coverage Elements

Element	Options
Sum Insured	Fixed amount, usually roughly equivalent to input cost, a portion of expected production value or margin.
Covers	Risk related with identified key perils
Perils	Identified key perils only (e.g. drought; wind; etc.)
Exclusions	Everything that is not defined in the Index payout structure
Payout	Based on pre-defined payout structure, usually a proxy for yield loss
Triggers	Typically defined so that major deviations from average yields are triggered
Settlement	Based on measurement and computation of indices that are proxies to yields
Resolution	Individual Farm → State-level

Index-Based Agriculture Insurance

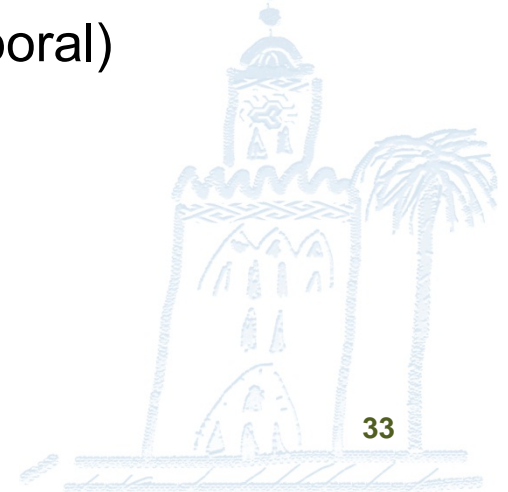
Advantages and Disadvantages

Advantages

- Less moral hazard
- Few information asymmetries because index based on widely available information
- Transparent and standardized structures
- Easier for risk transfer of wide spread correlated risks
- Low administrative costs
- Government financial liabilities could be budgeted upfront

Disadvantages

- Basis risk
- Sometimes requires understanding of complex statistical properties of indices
- Requires 'agro expertise' in selection of indices for crops
- Sufficient weather data (spatial and temporal)
- Simulation of correlated indices (spatial and temporal)



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