Assessing remote sensing for index insurance: the WRMF project in Senegal

G4AW Week
21st December 2015
Ministry of Foreign Affairs of the Netherlands

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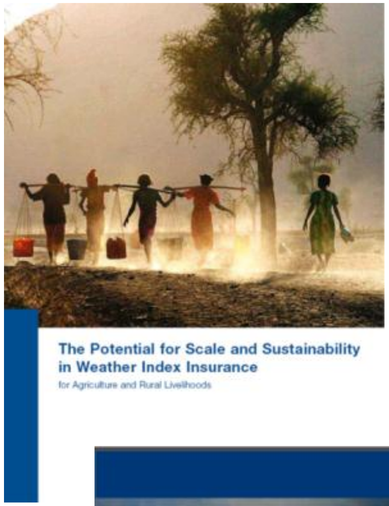
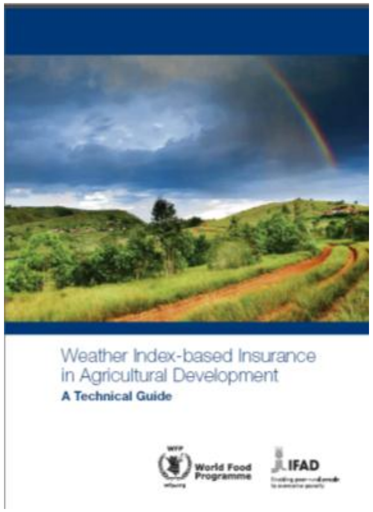
1. Background to WRMF and index insurance
2. Overview of the project
3. Ground data and farming systems
4. Evaluation criteria and process
5. Performance analysis

1. Background to WRMF and index insurance

IFAD-WFP WRMF
Weather Risk Management Facility

- IFAD-WFP partnership on index insurance since 2008
- Focus: **smallholder farmers**
- Index insurance as one tool with potential to:
  - Reduce smallholder vulnerability
  - Enhance food security
  - Unlock access to credit and investment in agriculture
- Part of a holistic approach to agricultural development and disaster risk management





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Strengths of Index Insurance

- Objective and transparent:
  - Eliminates most of the asymmetric information problems of MPCI (moral hazard and adverse selection)
- Improved access to insurance:
  - Reduced administrative costs - no loss assessment required
  - Simplified claim process and timely payout
- Facilitates risk transfer outside of the local community (insurance/reinsurance)

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Weaknesses of Index Insurance

- **Basis Risk**: potential difference between the loss experienced by the farmer and the payout triggered by the index.
- **Replication**: Products need to be specifically tailored to each location and crop, which requires considerable technical work.

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Main requirements for scale and sustainability of index insurance

- Local capacity and ownership
- Insurance awareness amongst potential clients
- Existing delivery channels e.g. cooperatives, MFIs
- Value proposition (linked to services e.g. seed, credit)
- Regulation
- Access to international risk transfer markets: reinsurance
- **Availability of quality weather and yield data at micro-level**

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2. Overview of the project

Researching new solutions - Remote sensing for index insurance

- IFAD-WFP WRMF project, financed by AFD, from 2012 to 2016
- Evaluate feasibility of remote sensing for index insurance to benefit smallholder farmers **at village level**
- Develop, test, validate, evaluate opportunities and constraints of indices created by different remote sensing methodologies
- Aims to contribute to:
  - Developing indices which can accurately **depict yield loss at village** level due to weather and other perils
  - Finding a sustainable approach to index insurance for smallholders
- Test-case Senegal, but results to be disseminated across the industry, and feed into IFAD and WFP programmes

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Project steps

- Research and set up
- Product development
  - Testing
  - Ground monitoring
  - Performance analysis
  - Evaluation
- Feed into pilot operations, e.g. R4; IFAD programmes
- Lessons and findings after 3-crop season cycle of development, testing and analysis
- Scaling up for IFAD, WFP and index insurance sector

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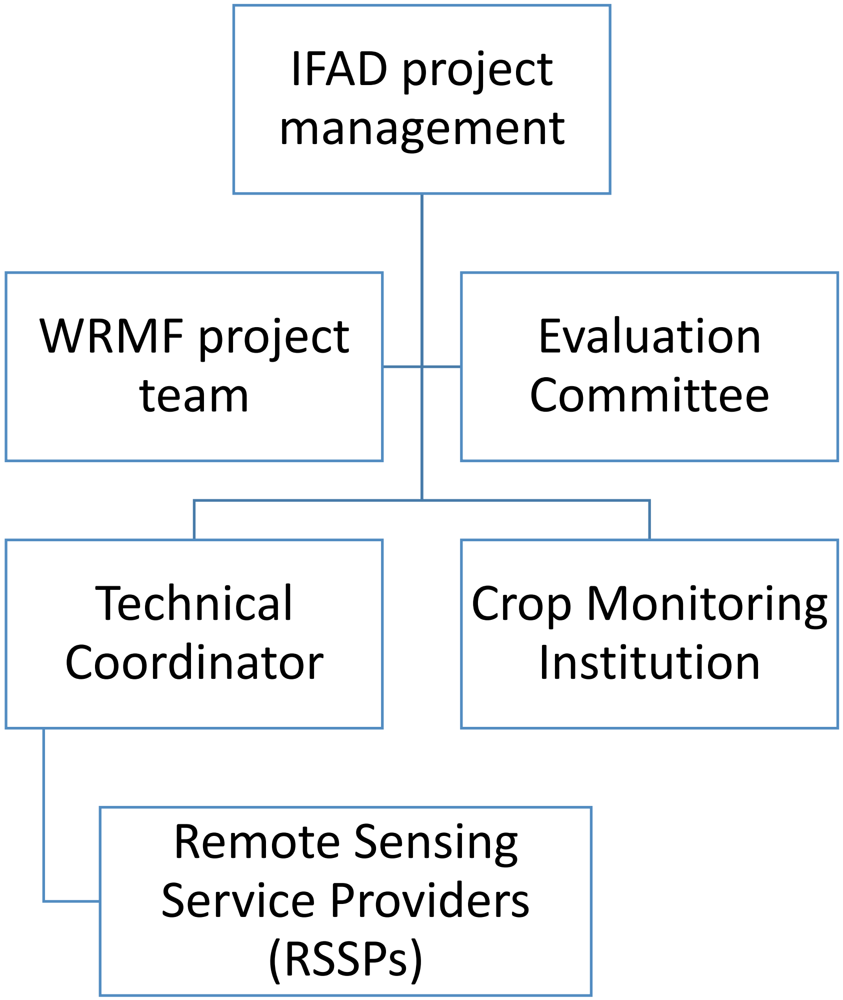
Project organisation



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Project focus 1: End-users

- **End-user perspective**: consider requirements of stakeholders in operating and maintaining a viable and sustainable system of II to cover smallholders

- Who are the **end-users** of RS index insurance ?
  - Project focuses on **insurers** as the primary **end-users**
  - Project focuses on smallholder farmers as “clients” (**micro level** insurance schemes)

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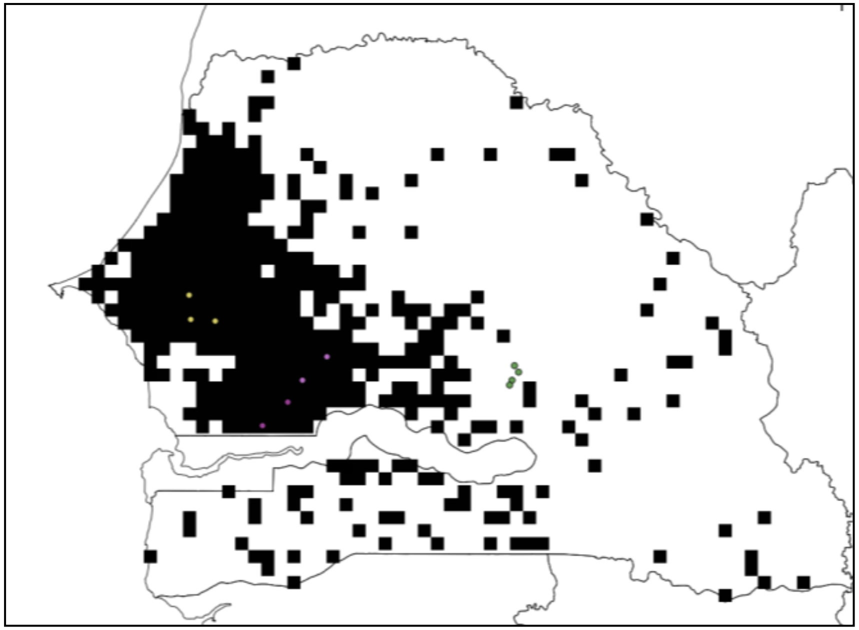
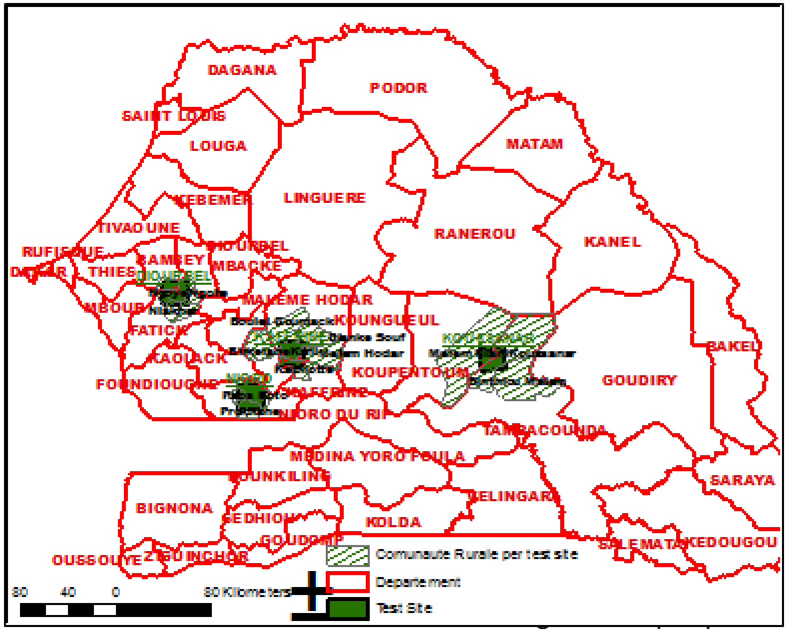
Project focus 2: Micro

- Focus of the project on **micro level index insurance**, as opposed to **meso** and **macro** applications

Example of a Macro Coverage: African Risk Capacity (ARC) WRSI pixels contributing to a policy for the government



WRMF Micro focus: How to design and manage insurance within a localised area to cover farmers or groups of farmers ?



RS methodologies and RSSPs

	EARS	FEWSNET	ITC	VITO	IRI	GeoVille
RS DATA	MSG Relative ET	MODIS Actual ET	SPOT-VGT- Proba-V NDVI	SPOT-VGT-Proba-V fAPAR TAMSAT-RFE	NOAA RFE2	ESA CCI Soil Moisture product (ECV SM Version 0.2)
Time series	1982-2014	2000-2014	1998-2014	1998-2014	1982-2014	1990-2014
Resolution	3*3 km	1*1 km	1*1 km	1*1 km; 4*4 km	10*10 km	25*25 km
Crop mask	no	Yes (aster based)	yes	Yes (JRC)	no	no
SOS	Fixed / floating	fixed	floating	floating	fixed	floating
UAI	Potential extension to zones	per crop over the regions	NDVI agro ecological zone	aCR	30*30 km	25*25km
Field data	Not needed Farmers info possible	Crop calendars Yield data per central CR	Village level data per agro ecological zone	Yield data per aggregated CRs	Yield data and village level info to select adverse years	No field information

» Crop maps/SoS indicators also developed by sarmap using COSMO-SkyMed data

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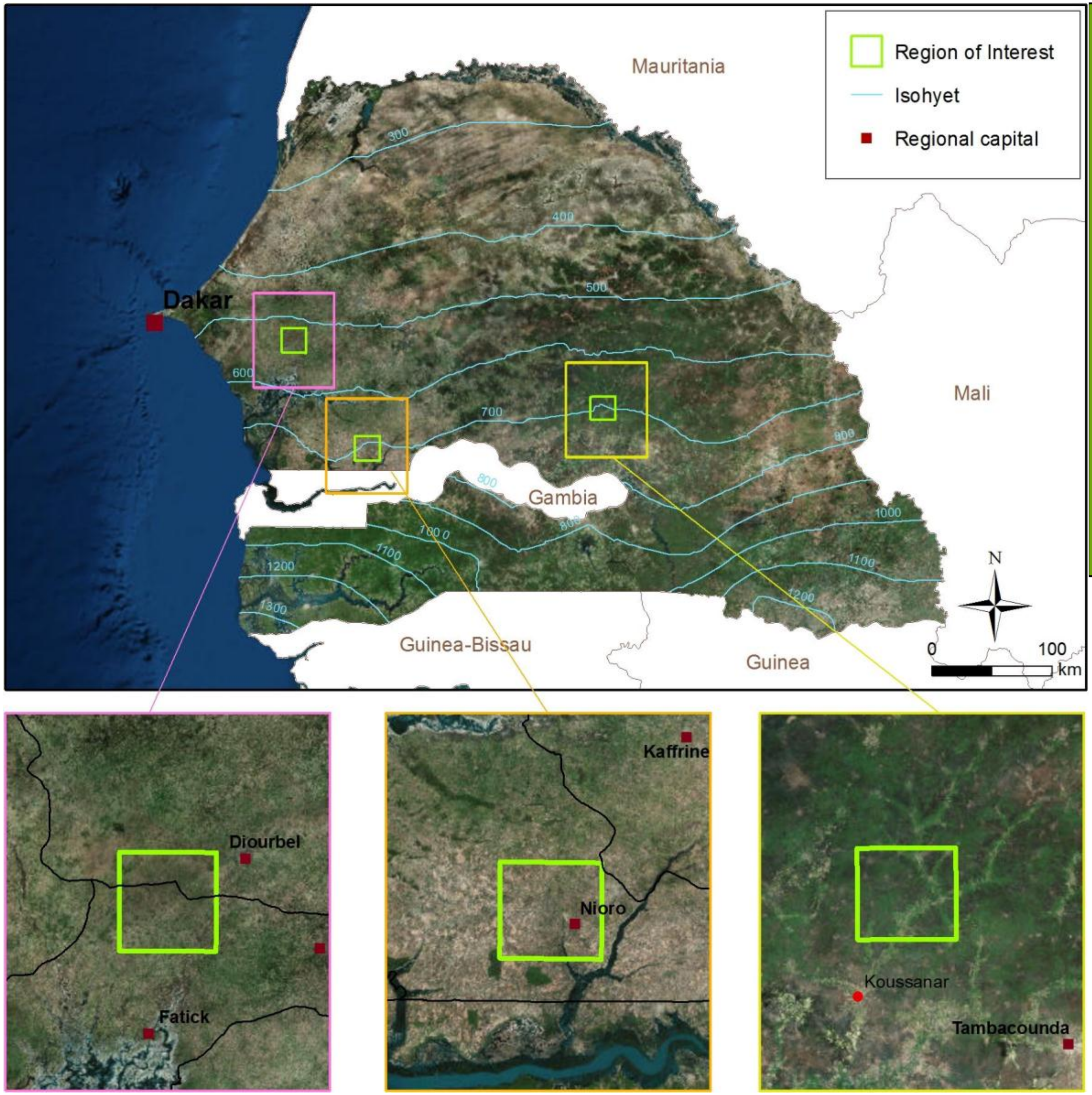
3. Ground data and farming systems

Regions of interest (test sites)



- Central Senegal
- 3 sites in: Diourbel, Nioro, Koussanar
- 20 km * 20 km test sites
- Groundnut; Millet; Maize

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Characteristics of the ROIs

- **Similarities betweeen ROIs**
  - Rainfed agriculture
  - Mixed cropping
  - Yield gap
  - Small field sizes (0.5ha – 3ha)
- **Differences between ROIs**
  - Rainfall gradient
  - Intensity of production/supply chain development
  - Land cover
  - Grazing land and bush important in Koussanar ROI
  - High cropped % land cover in Diourbel, Kaffrine and especially Nioro
- **Features of cropping at village level**
  - Champs de case
  - Champs de brousse

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Yield datasets

- **Departemental level data**
  - Official DAPSA data, long time series
- **Communaute rurale (CR) individual sample level data**
  - Purchased from DAPSA, 2001-2015
  - Research data from ISRA/CERAAS past crop monitoring
- **CR yield data used in 2 ways for validation analysis**
  - At central CR level (cCR)
  - Average of adjacent CRs (aCR)

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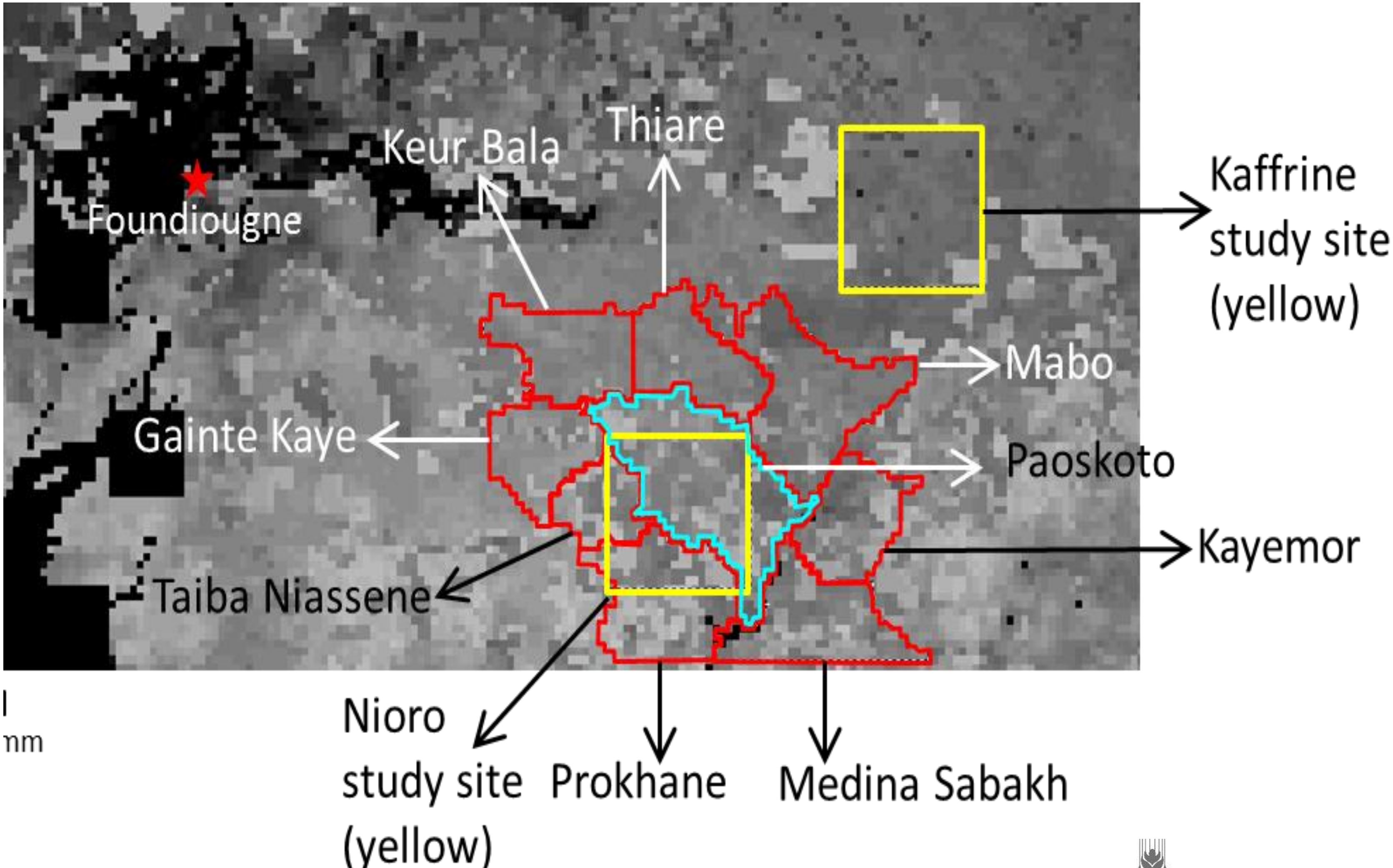
Nioro ROI and CRs



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Dedicated in-field data collection

- Crop Monitoring of Start of Season, Phenology, Crop Conditions etc
- Rain gauges installed in villages
- Yield samples in monitored fields
- Photography of fields introduced
- 4 villages per 20km x 20km area
- 30 fields per crop type, 3 crop types (maize, groundnut, millet)

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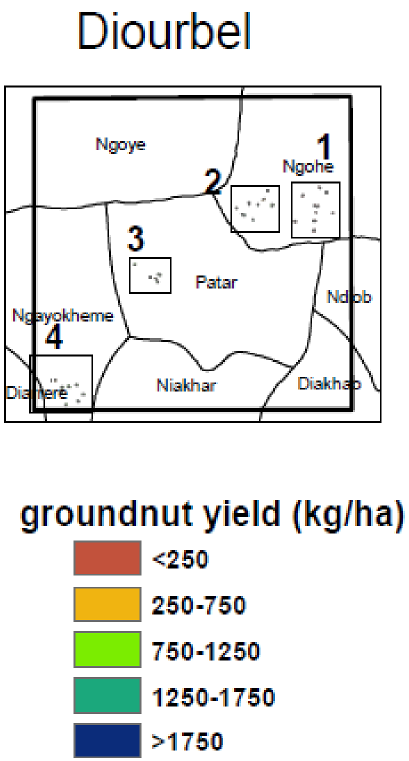
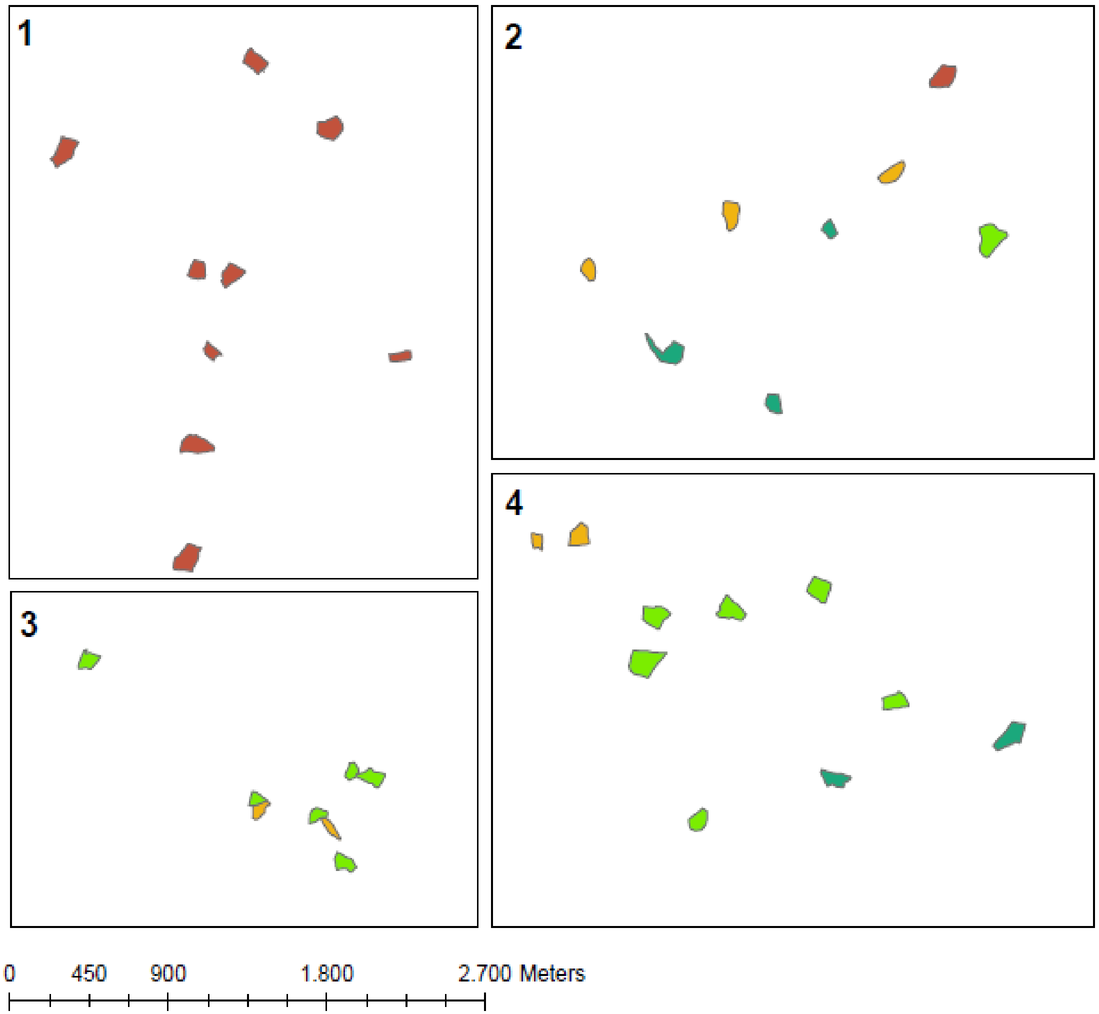
Example outputs of in-field data collection



min	38
max	1588
average	712
stdev	472
cv	0,66



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Additional data sources

- Qualitative data obtained by focus group meetings in monitored villages
- Many research and data sources are available to assist in interpretation
  - Agric research findings e.g. ISRA/CERAAS/CIRAD
  - Mapping and AEZ, zoning, land use, climate analysis e.g. CSE, Anacim
  - Food security and rural populations e.g. WFP
  - Household surveys, official statistics
- Existing insurance programme results in Senegal
  - Planet Guarantee, CNAAS (agricultural insurance company)

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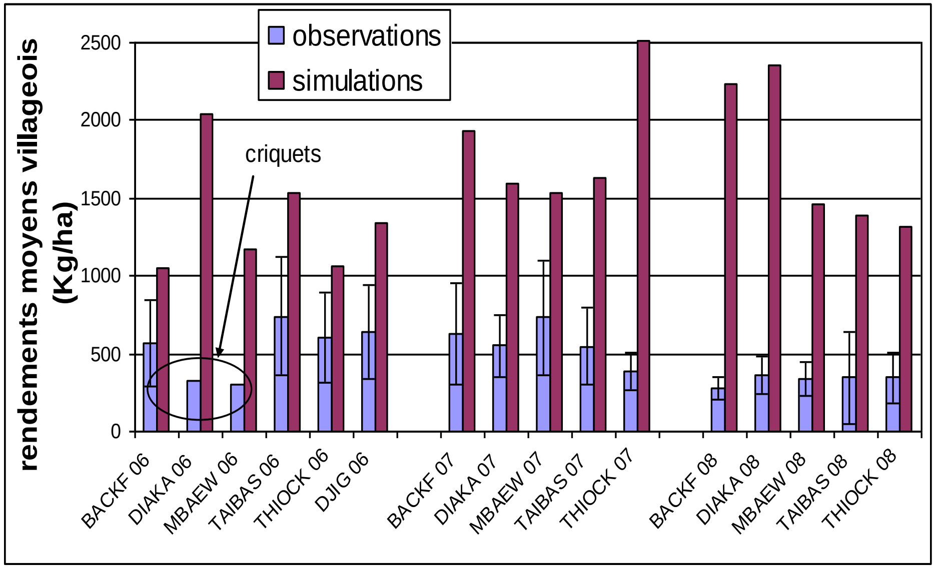
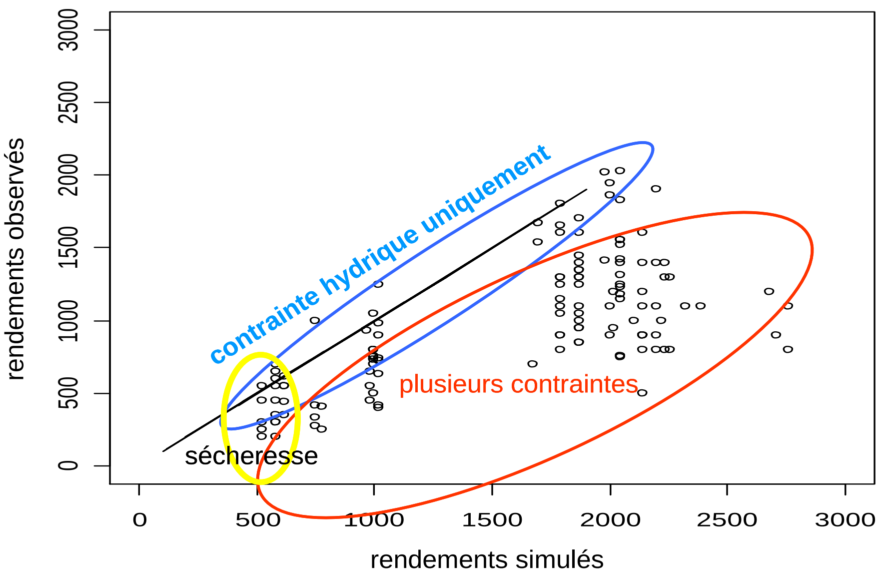
Some findings on yields

- Massive variability of crop yields at individual farmer level, in same year in same villages
- Difficult to assess “normal” farmers actual yields by crop models
- “Yields gap” is important (optimal v actual yields)





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4. Evaluation criteria and process

Evaluation of project results

1. Analysis of index performance

1.1 Historical analysis and calibration

1.2 Field tests assessments of insurance indices' performance

1.3 Field tests for assessing accuracy of mapping products

2. General evaluation criteria

2.1 Availability of base data and supplementary data/information

2.2 Cost and sustainability of data acquisition, data processing, and product development

2.3 Ownership and transparency

2.4 Performance and suitability

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The Evaluation Process

- **Evaluation will be carried out in 2016 after completion of tests in the crop seasons of 2013, 2014, 2015**
  - Historical Performance Analysis
  - Field index testing
- **Evaluation criteria**
  - Focus on end-user needs
  - Overall performance based on “technical performance” and “operational application”
  - Ranking of each criterion

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5. Performance analysis

Historical Performance Analysis

The objective of the Historical Performance Analysis is to **assess how effective the RSSPs have being in capturing historical losses**

- Indicates the **effectiveness of design and calibration**
- Considering the **inherent limitation of projecting the future from the past** in an environment with scarce data and dynamic conditions, the HPA is a **"second best" indicator** of the ability to capture the relationship between the index and the insured variable
- Assigning excessive value to the HPA generates incentives to overfit, so **complement with in-field index testing**
- Revision of indicators based on Year 1 feedback

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How to Analyze Results

In index insurance, "**non-accurately performing**" **events** could be considered situations in which:

- A payout is **expected** but it is **not triggered** (**"false negative"**)
- A payout is **triggered** when it is **not required** (**"false positive"**)

However, the index would also not be performing well if

- The **payout and the yield deviation are significantly different** in size (e.g. a 2% payout with a 90% loss).
- Technically a payout is triggered but it does not cover the loss.

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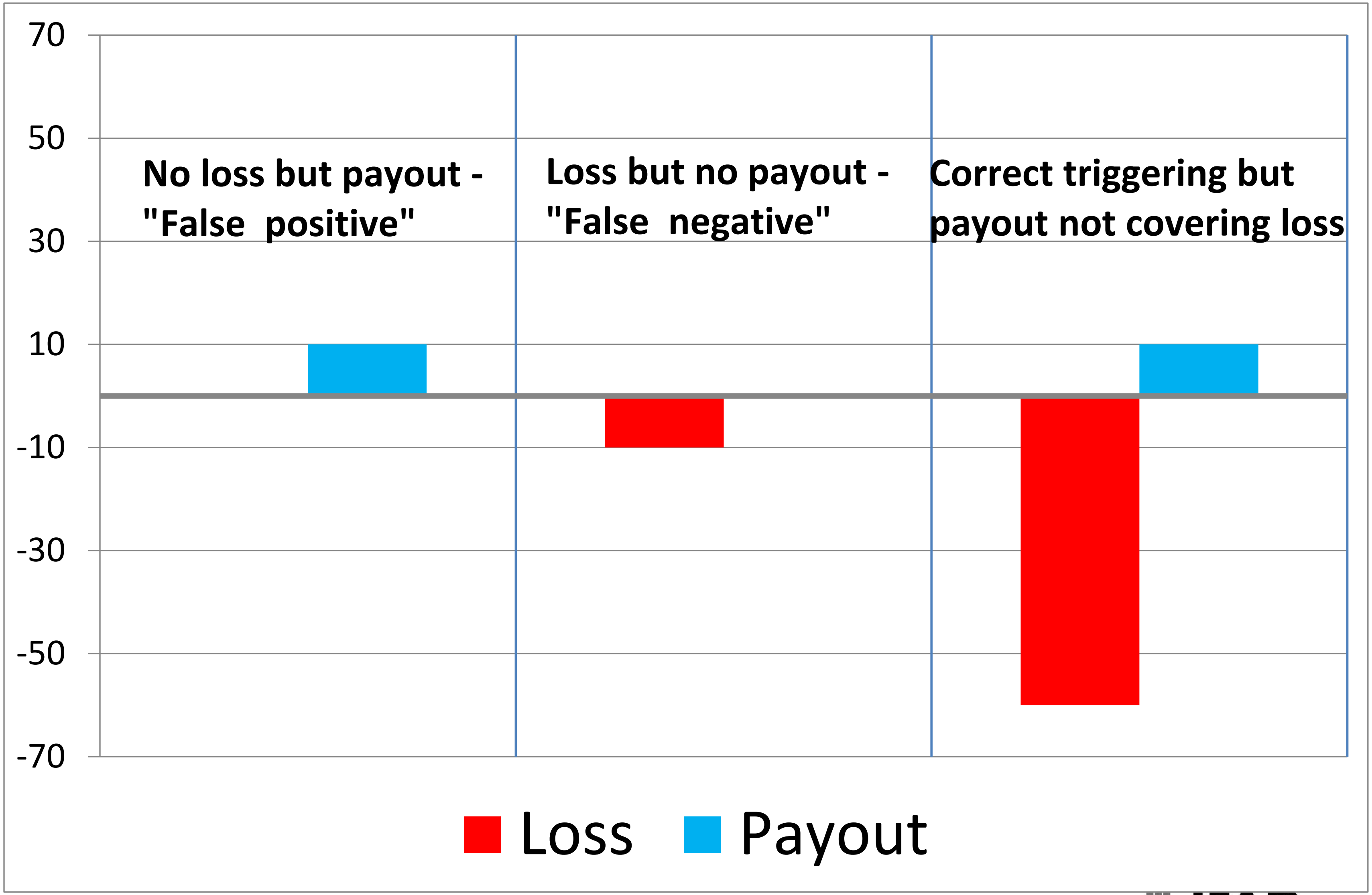
Which is more relevant?



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Classification of Events

Class and color code	Definition	Final classification
Correct	*If payout is provided or not provided in accordance with yield behaviour, within a deviation of 5 percentage points*	Correct + Acceptable mismatch
Acceptable mismatch	*If the mismatch between yield deviation and payout is within 15 percentage points. This class includes events not performing correctly (false positives and false negatives) as long as within a 15 percentage points deviation.*	
Not acceptable mismatch	*If mismatch between yield deviation and payout exceeds 15 percentage points.*	Not acceptable mismatch + Not correct
Not correct	*If not correct (false positives and false negatives) and mismatch above 15 points.*	

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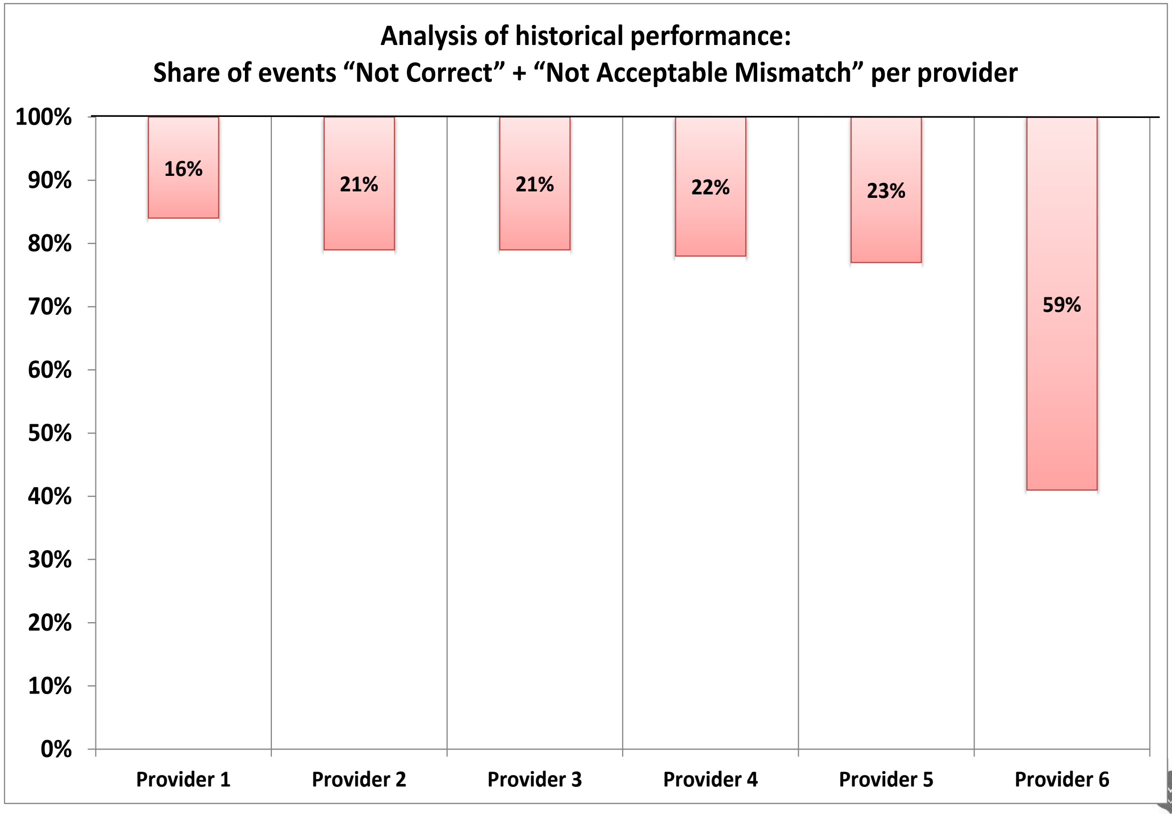
Initial Indications on Share of «Not Correct» Events

- Share of **events that are not correctly matching** the observations.
- A good reminder of the challenges of perfectly capturing losses, and of the **unavoidable presence of «basis risk»**



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Base Case and Fixed Expected Loss Cost (ELC) scenarios

- Aim: **Assess index performance also when cost of the insurance coverage are comparable**
- This can be done by asking Service providers to develop scenarios with same Expected Loss Cost (i.e., the average of historical payouts)
- Remote sensing providers re-worked their indices to provide Fixed ELCs, in addition to their "base indices"
- Fixed ELC levels set at 4% millet, 6% groundnut, 8% maize

What we know so far about the methodologies

- Some methodologies **perform better for certain crop-area combinations**
- Overall better performance with **millet and groundnut**, varied performance with **maize**
- **Segmentation of areas** based on maps and masks could increase performance of methodologies, especially those based on vegetation indices and on evapotranspiration
- **Three-years analysis** crucial
- **Methodology for analysis** is key

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Availability of base data and supplementary data/information

- For what **historical period** is the base data used for the index development available?
- At what level of **spatial resolution** is data collected?; Is it available at global level, Africa-wide, or only for specific areas and situations?
- What **supplementary data** (e.g., crop calendars, agricultural practices, weather data) **is required** for effectively implementing the methodology?

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Cost and sustainability of data acquisition, data processing, and product development

- Is the **base data free**, or does it need to be purchased?
- Is the data **available in near-real time** (few days); Is the development process labour intensive, or can it be significantly automated?
- What are the **capacity building needs to develop processing and index design** on a national or regional basis?
- Once adapted to a specific area, is the methodology **easily scalable elsewhere** in Africa, or does it require significant work for each Unit Area of Insurance (UAI) to be covered?

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Ownership and transparency

- If the methodology is not proprietary, how technically challenging is it to **be replicated/adopted by other institutions**?
- Despite being proprietary or not, how are the processing algorithms available for **audit in the event of a dispute**?
- Would it be **technically feasible to transfer the necessary know-how** to develop the indices to organizations or companies in the countries of implementation?

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Performance and suitability

- Do the indices developed **only cover drought**, or do they capture **other perils as well**?
- Can the methodology **discriminate between agricultural and non-agricultural** activities?
- Can the methodology **discriminate between crops**?; Does the methodology show strengths and weaknesses in **specific parts of the crop season**?
- How **complex** is the product in terms of explaining its operation to potential clients?
- Does the methodology and its index development have **direct spin-off benefits** for other end-user applications in agricultural risk management or early warning?

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Thank you

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