

COINS

co-developing innovations for sustainable land management in West African smallholder farming systems



Co-Developing Innovations for Sustainable Land Management in West African Smallholder Farming Systems

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COINS – Facts & Figures

Co-Developing Innovations for Sustainable Land Management in West African Smallholder Farming Systems

1 of 4 regional research projects within the call “Sustainable land management in Sub-Saharan Africa: Improving livelihoods through local research” within the framework of the Research for Sustainability (FONA) strategy of the German Federal Ministry of Research; Technology and Space

Accompanied by the INTERFACES project

Funding period

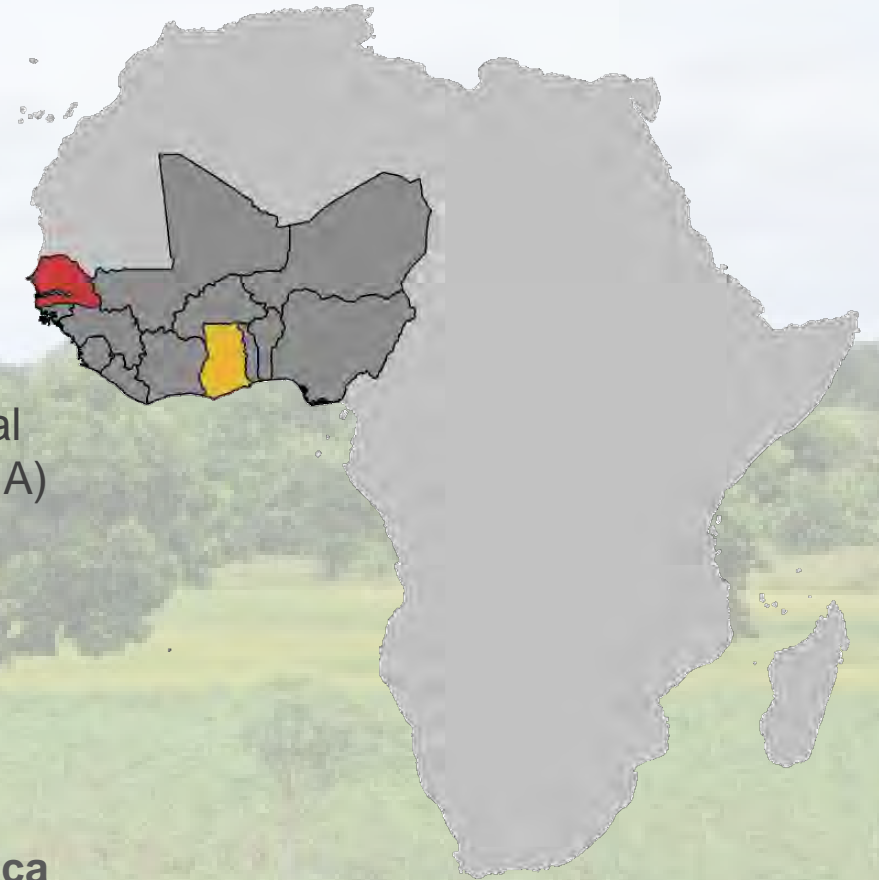
01.10.2022 - 30.09.2026

Project Partners in Germany

DLR-DFD, Ruhr-Universität Bochum, United Nations University - EHS, Universität Bonn, Universität Hohenheim, ZALF

Project Partners in Africa

ACRE , Manobi , IPAR , SARI, United Nations University – INRA, University of Ghana, WASCAL



With funding from the:



Federal Ministry
of Research, Technology
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zalf



DLR-PT



WASCAL
West African
Science Service Centre on
Climate Change
and Adapted Land Use



acre
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CSIR
SCIENTIFIC AND INDUSTRIAL
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GHANA



UNIVERSITY
OF GHANA



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UNU-INRA
Institute for Natural Resources in Africa



ipar
Initiative Prospective Agricole et Rurale



ICRISAT
INTERNATIONAL CROPS RESEARCH
INSTITUTE FOR THE SEMI-ARID TROPICS



Manobi Africa

Background

- Sub-Saharan Africa: currently **multiple risks (climatic, social, economic, ecological)** with partly uncertain future developments
- Projected population development in **West Africa** from 400 million to **1.2 billion** in 2100
 - Rising population as driver for:
 - Increase in cropland
 - Increase in livestock
 - Consequences:
 - Loss in carbon
 - Loss in biodiversity
- **Intensification** of currently used agriculture area is needed
- **Agriculture area** already under pressure due to land degradation and desertification
- Solution: **Sustainable Intensification (SI)**



Objectives



Sustainable intensification (SI):

"a process or system where agricultural yields are increased without adverse environmental impact and without the conversion of additional nonagricultural land"

(Pretty & Bharucha, 2014)

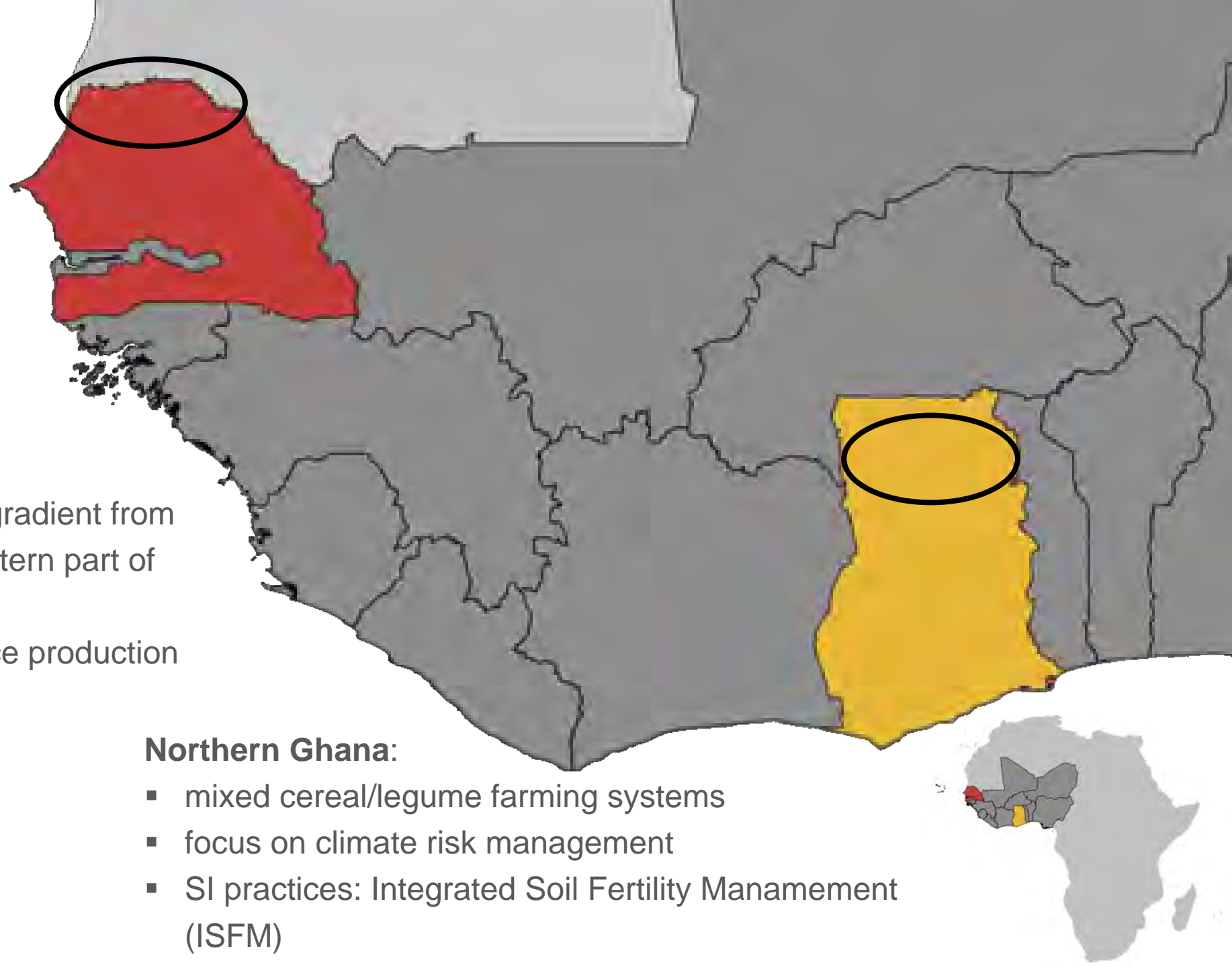
SI implementation at larger scales often limited because of:

- Lack of knowledge on heterogeneous socio-economic and environmental conditions
- high labor costs
- limited access of farmers to financial services

Solution:

- Creating **incentives** and **structures** that **enable sustainable land use** to improve livelihoods and **food security**

Study Regions



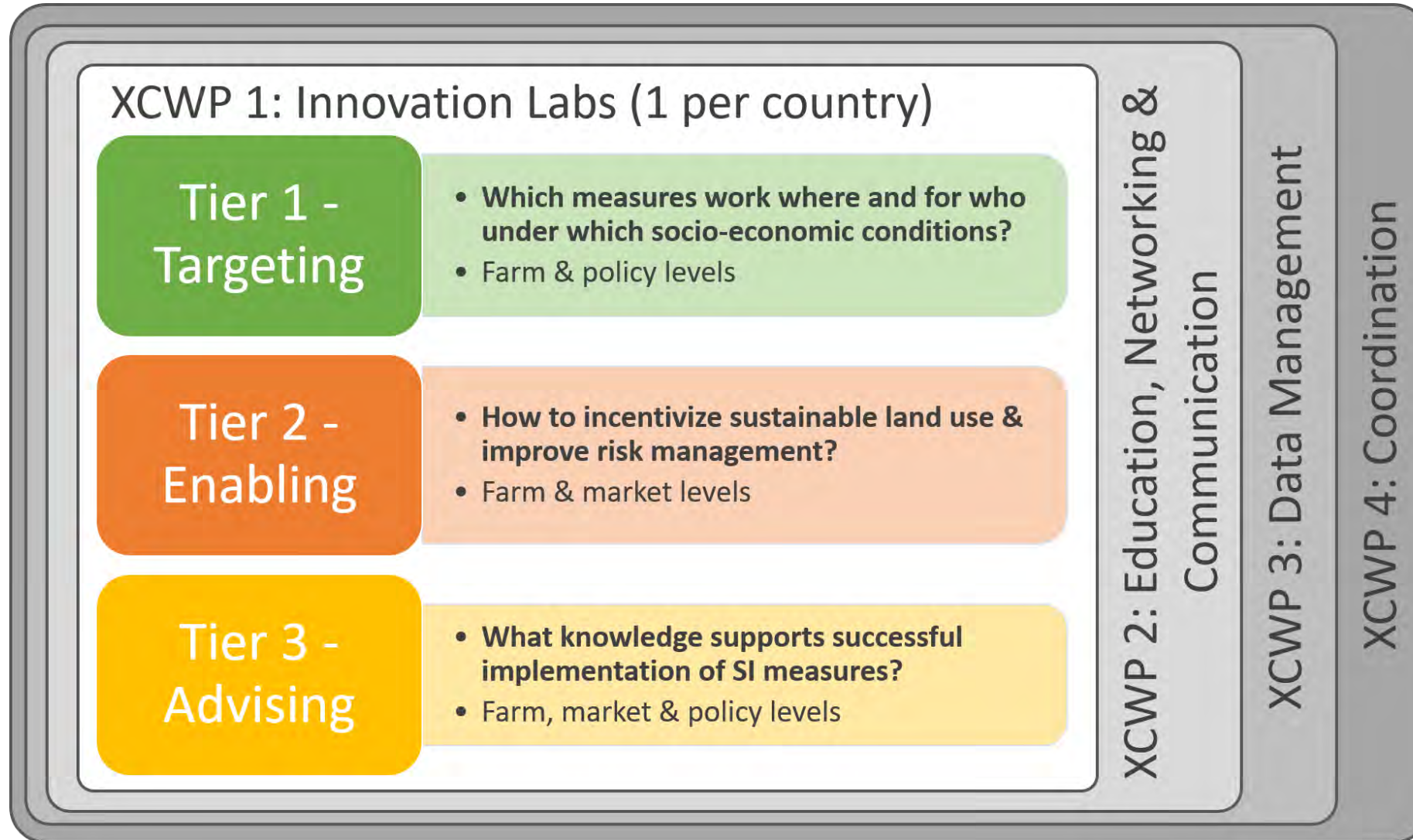
Senegal River Valley:

- irrigated rice
- Strong socio-economic gradient from coastal region to the eastern part of the Senegal river valley
- increasing support for rice production but decreasing of yields
- focus on systems of rice intensification (SRI)

Northern Ghana:

- mixed cereal/legume farming systems
- focus on climate risk management
- SI practices: Integrated Soil Fertility Manamement (ISFM)

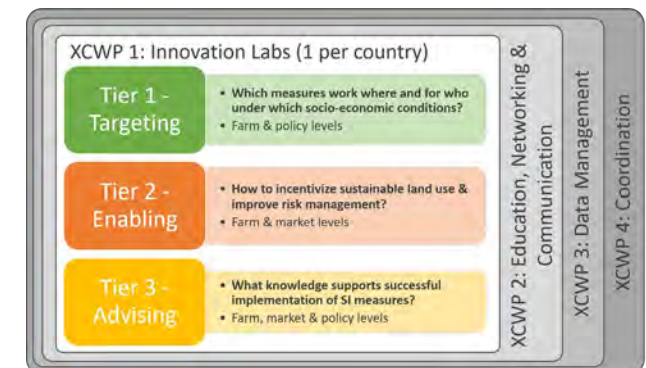
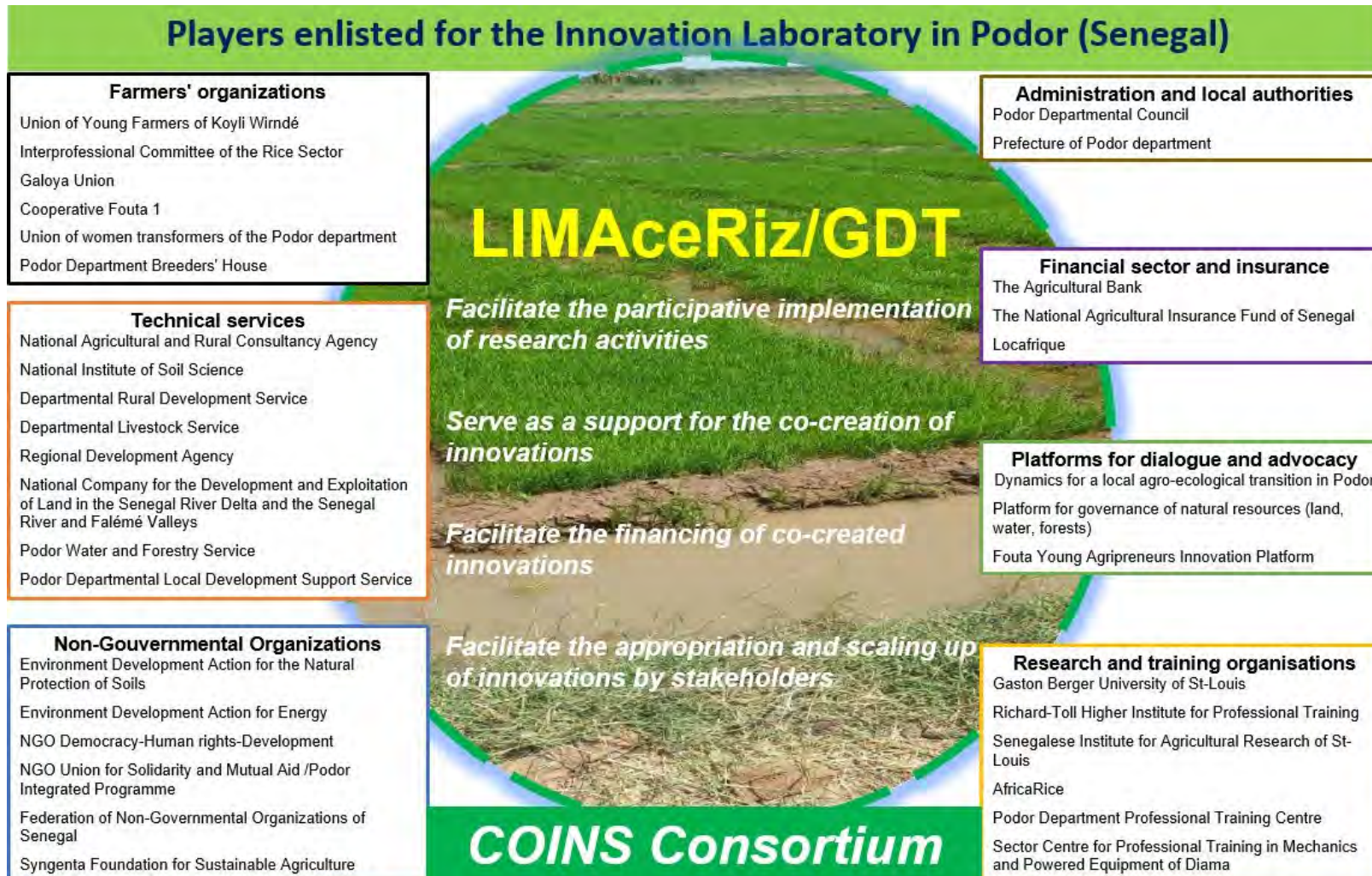
Approach and Structure



Innovation Labs

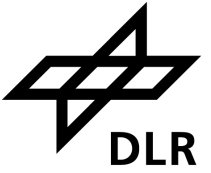
Innovation labs are a platform to find the most suitable SI practices for each region

SI practices can demonstrate to farmers (FFS)



Farmer Field Schools

Transplanting of 20-day-old rice nurseries



Farmer Field Schools

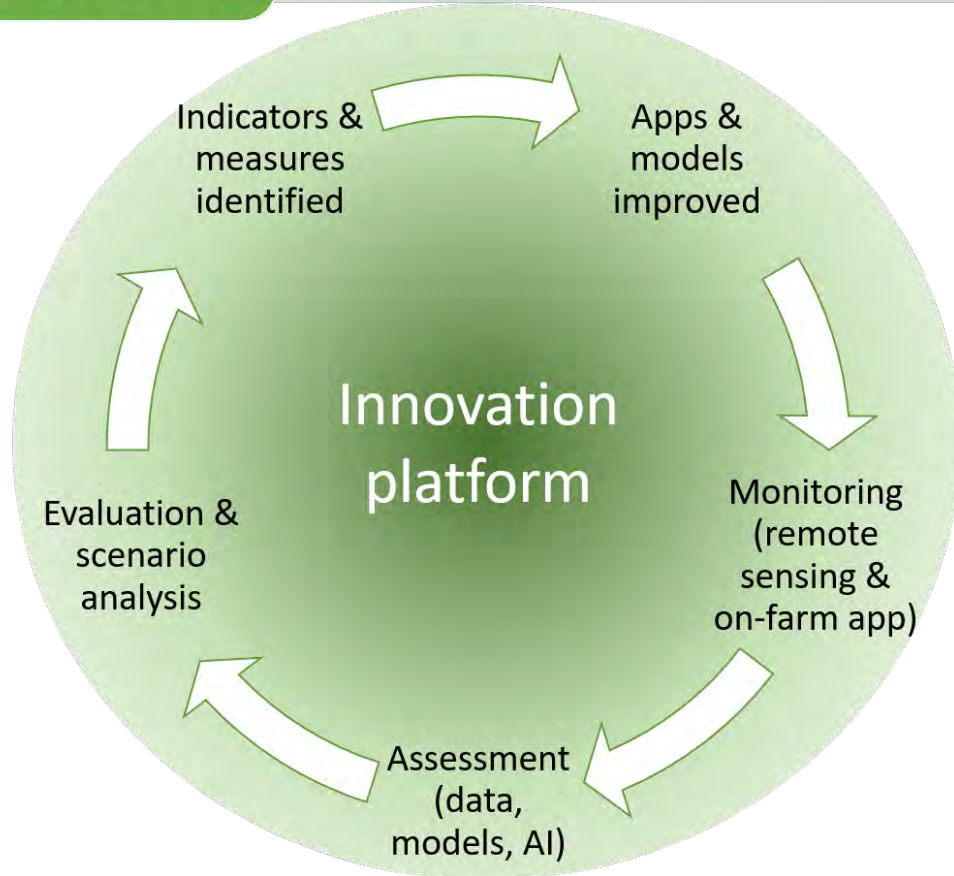
Left: SRI, Right: conventional practice



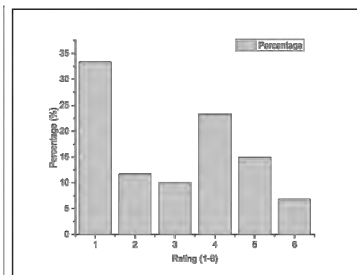
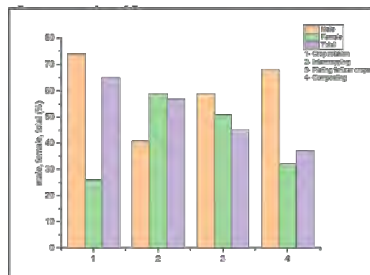
SRI yields increase by an average of 30% compared with conventional rice cultivation

Tier 1: Targeting

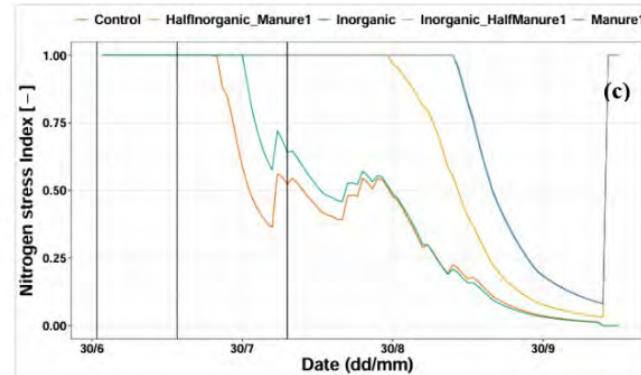
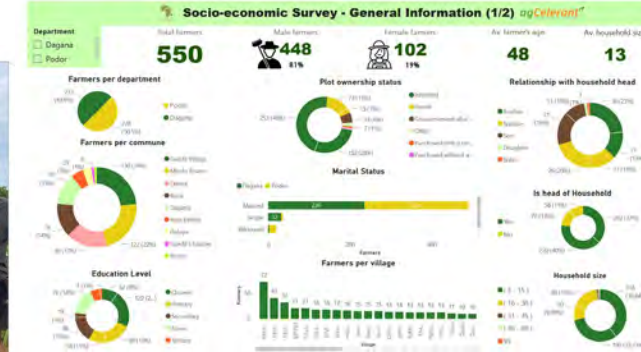
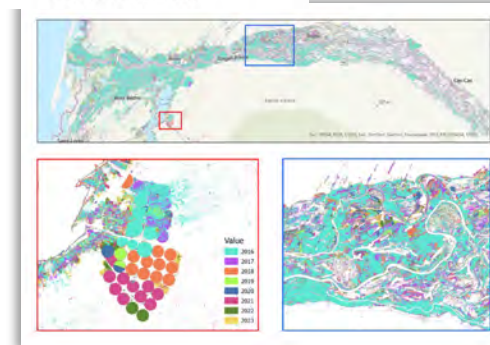
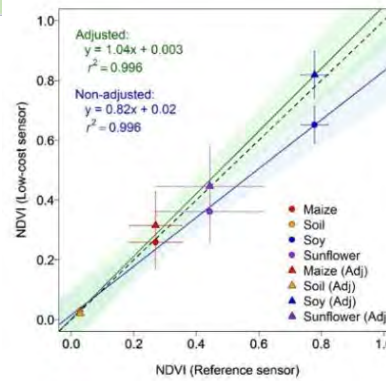
- Understand where and for who measures work



Key activity: Survey on farmers' coping strategies and social cohesion mechanisms



Measurements: GHG Emission

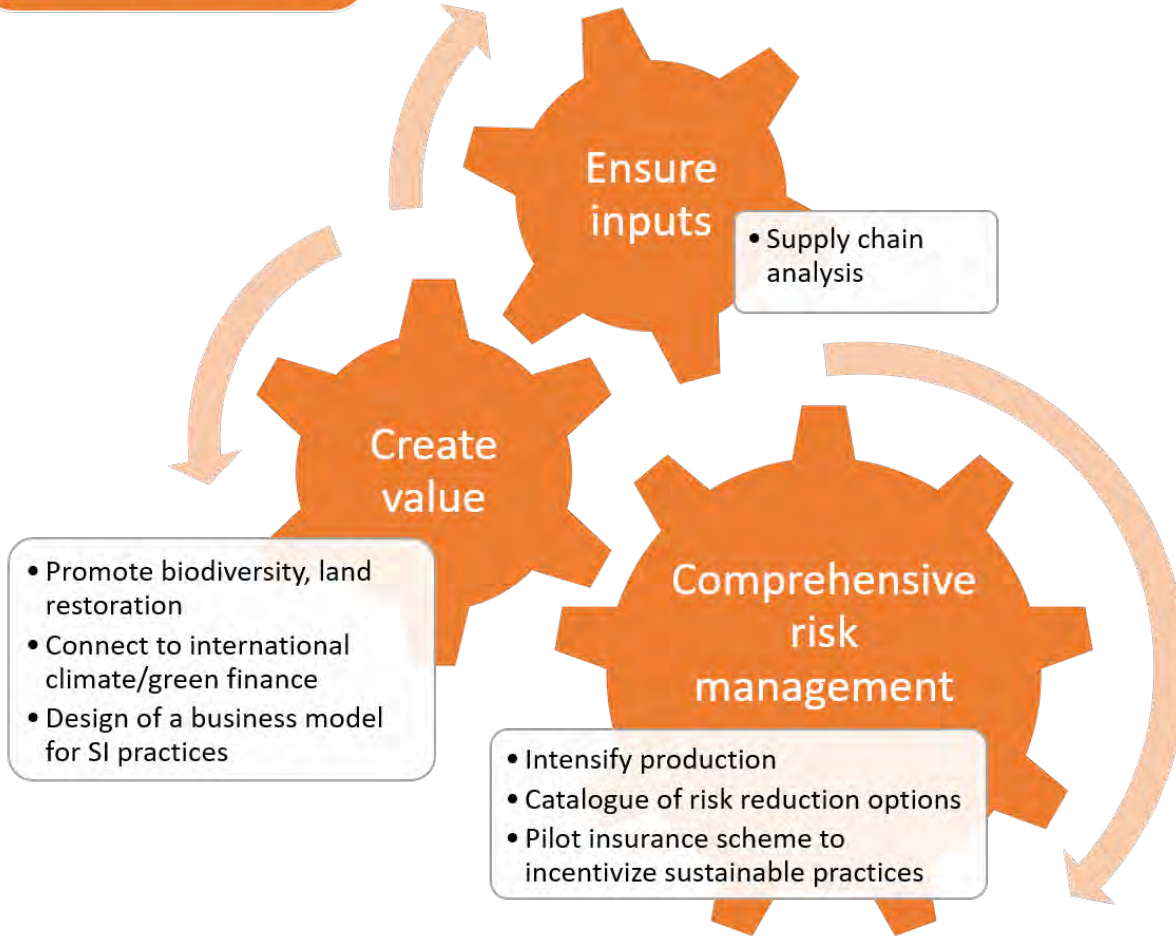


Key activity: COMBI traps and pitfalls installation



Tier 2: Enabling

- Incentivize sustainable land use



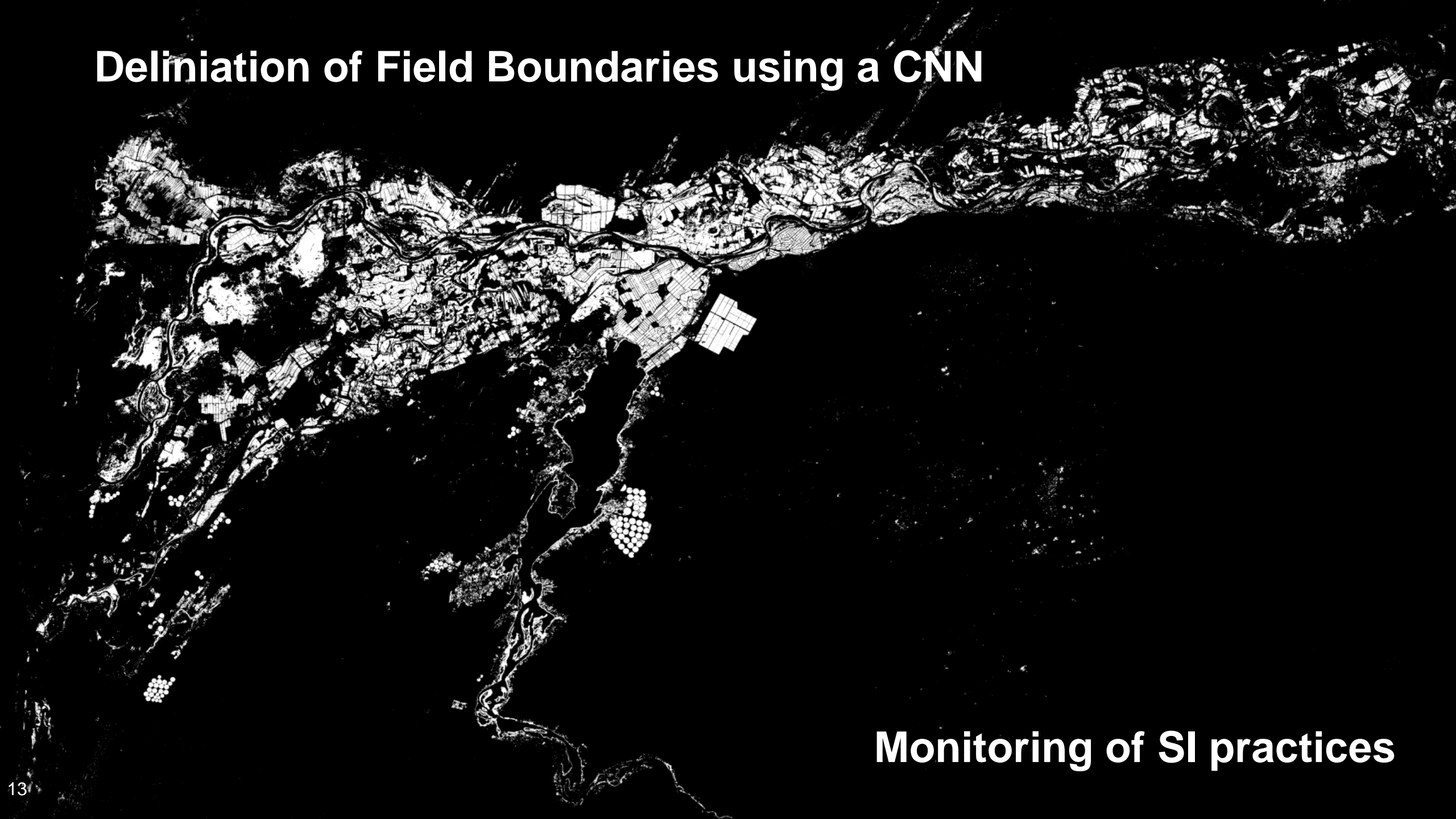
- Main objective:
 - Understand what incentivize sustainable land use
 - Value supply chain analysis
 - Model different risk management decisions
 - Model potential outcomes of business models with/without application of SI practices
 - Develop a insurance instrument
 - Prototype of a monitoring system

Role of incentives on technology adoption

- Understanding mechanisms behind adoption of SI practices
 - Experiment on how upfront costs and insurance affect farmers' adoption of drought tolerant seeds
 - 400 households in 18 villages were involved
 - Severe drought in 2024 and reduced harvests highlighted the importance of the topic
 - Key message: financial incentives – like insurances – can enable technology adoption but the design, (e.g., conditional vs. not conditional) is key!
 - When insurance is conditional on applying drought tolerant seeds farmers are more prone to adopt it



Delimitation of Field Boundaries using a CNN

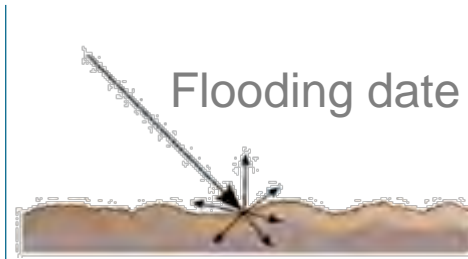
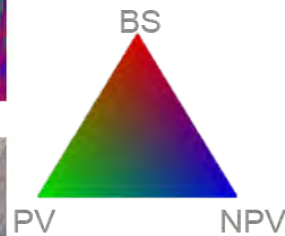
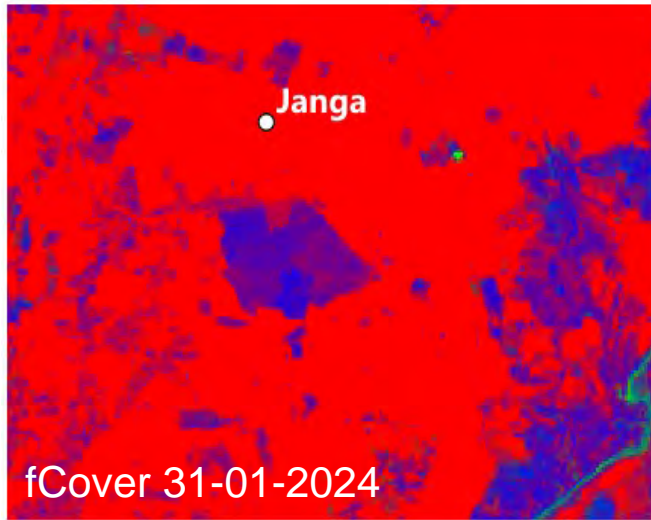


Monitoring of SI practices

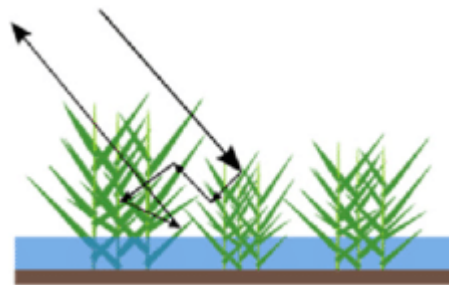
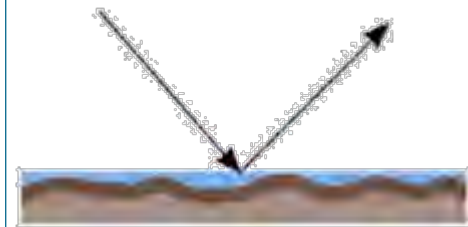
Identification of Agricultural Management Events



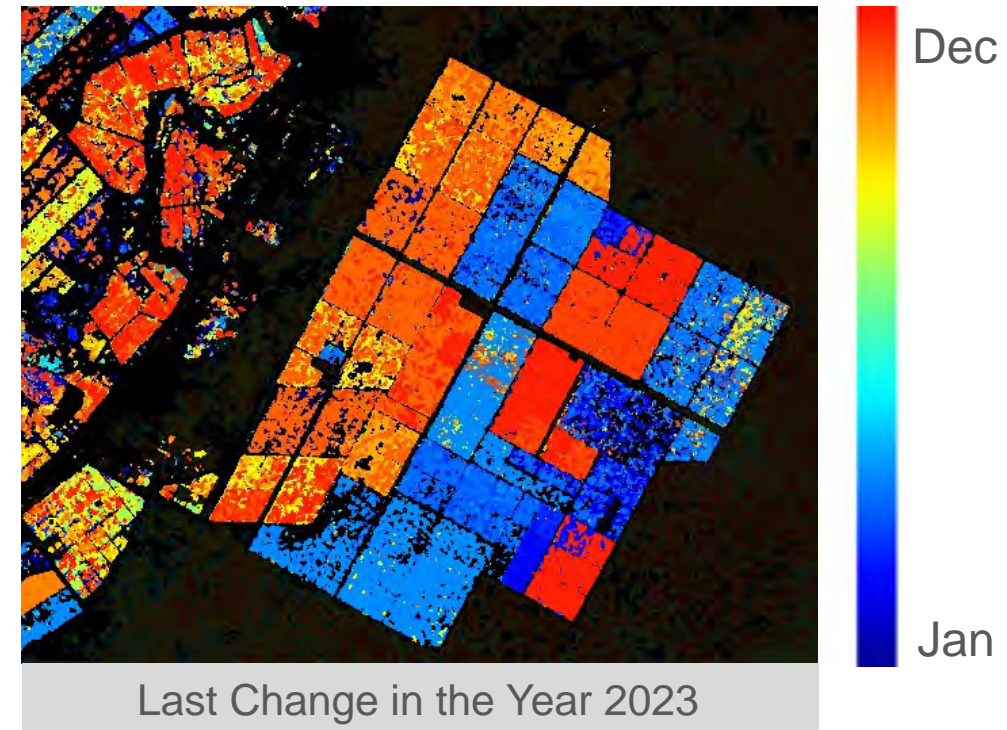
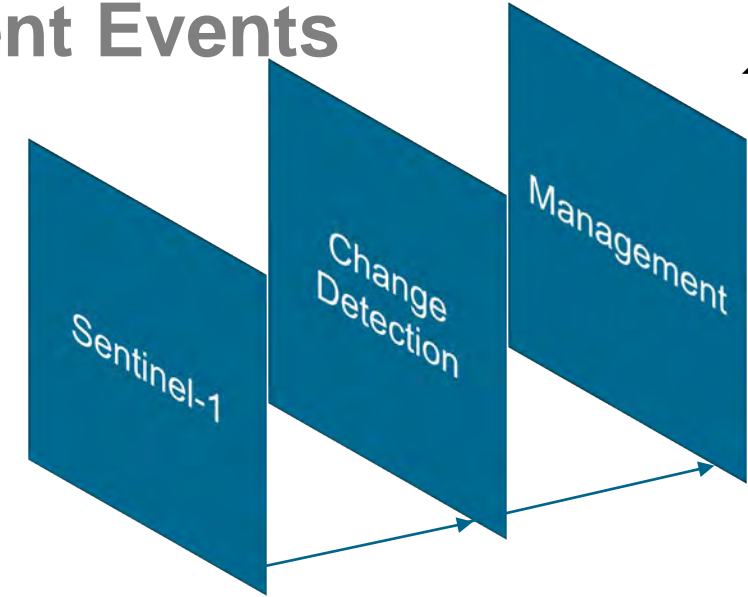
Crop residue management



Before field preparation:
Diffuse backscattering

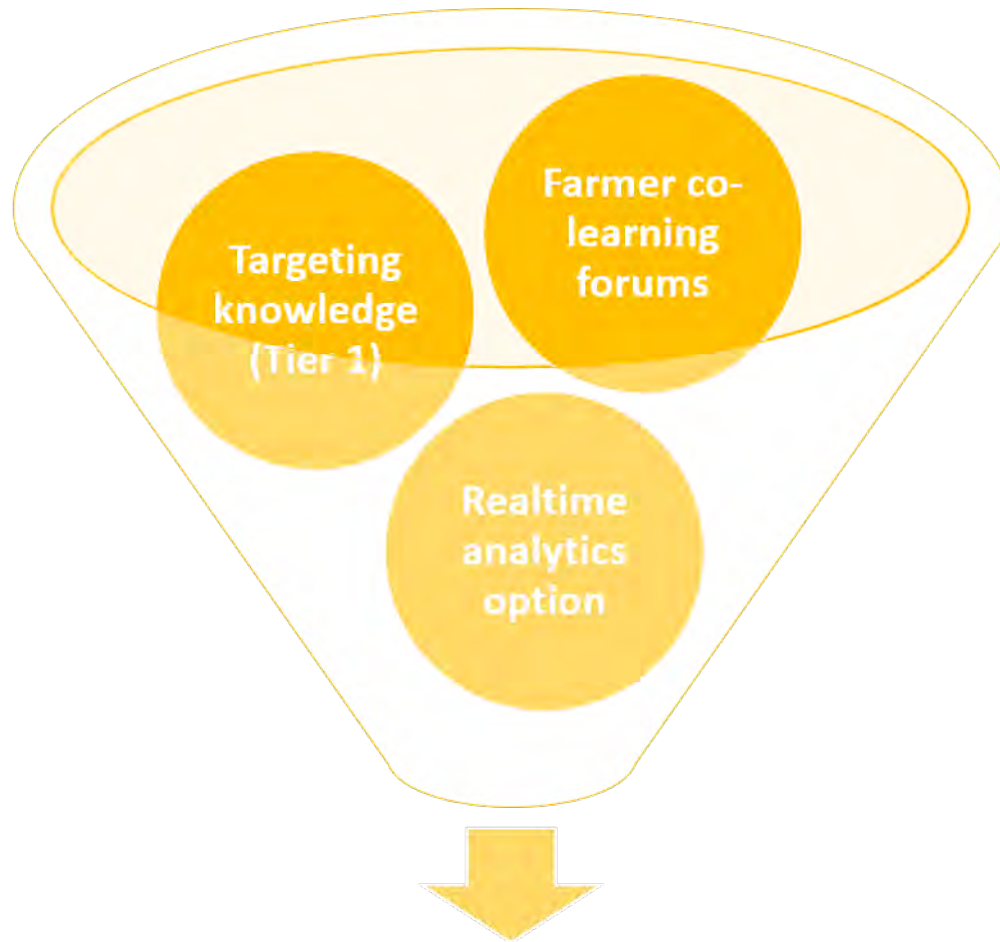


Modified after Ottinger & Künzer
(2020)



Tier 3: Advising

- Knowledge for sustainability



Within and between season
farmer specific advice

What knowledge supports successful implementation of SI practices:

- Community Workshops
- Participatory Mapping
- E-Learning Material
- Service Product Development
 - Feedback from/to farmers/farmer organizations
- High-Level Risk Advisory Network
- Farmer Field Schools

Farmer Field Schools



Objectives

- Conduct field visits to study sites
- Observe and understand barriers to SI & SRI adoption
- Facilitate focus group discussions with farmers



Community Workshops



Participatory Mapping



E-Learning Materials

Swipe between the images below to compare average monthly vegetation condition on cropland in Burkina Faso in 2000-2020 with NDVI anomalies and precipitation anomalies in 2015.

Have a look at the connection between precipitation anomalies (i.e. above or below average rainfall) and NDVI anomalies (i.e. above or below average vegetation greenness) from April to July 2015, as well as the time lag of about a month after increased rainfall from August onwards.

Note also that the positive NDVI anomaly carries over into the months of October through December, although rainfall has returned to average values.

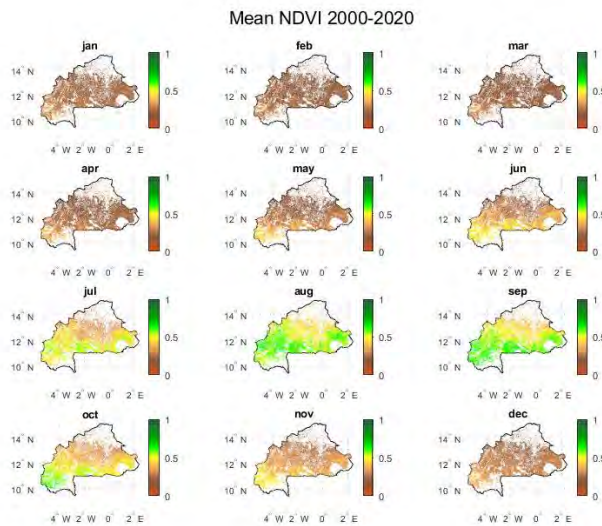


Figure 1: Mean NDVI for agriculturally used land in Burkina Faso 2000-2020

Which low-cost sensors exist and for what can they be used?

To measure environmental values, we need sensors. Low-cost sensors are a cost-effective and simple solution.

Below you will find a small overview with some example sensors:

Soil Moisture Sensor

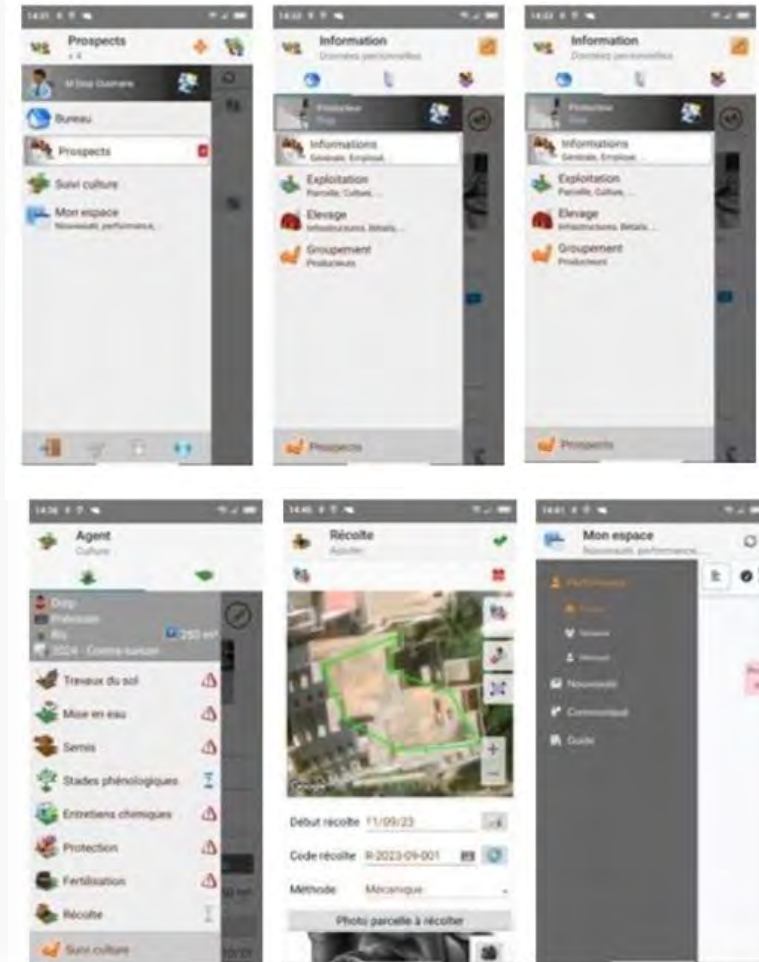
A soil moisture sensor measures the water content in the soil, helping to determine when plants need watering. It is commonly used in smart gardening.



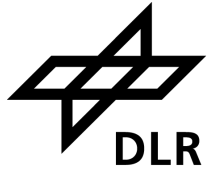
Acceleration sensor ADXL335:
The ADXL335 is a 3-axis accelerometer that detects motion and tilt. It is commonly used in robotics, motion tracking, and wearable technology.



Service Product Development



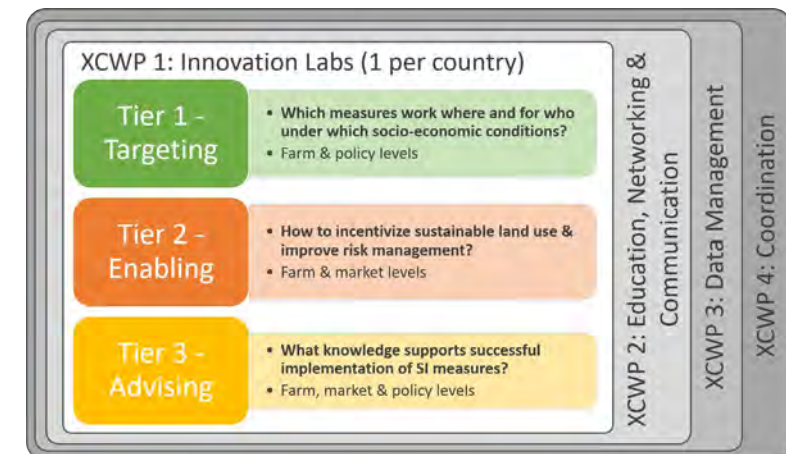
Education, Networking, Communication



Key Objectives

Build new alliances, strengthen regional research:

- co-generation of knowledge
- strengthen existing Innovation Platforms and increase capacity of the Innovation Labs
- bring together financial service providers for crop and livestock insurances, farmers, technology developers, extension services and researchers
- ensure capacity development in academia with the aim to link science to the people



Next steps

- Continuation of Innovation labs
- Launching of e-learning material
- Operating monitoring (GHG, agr. Management, productivity)
- Calibrated crop model to regional scale
- Synthesis for targeting
- Evaluating financial instruments
- Monitoring system of SI practices
- Scientific publications



With funding from the:



Federal Ministry
of Research, Technology
and Space



Thanks!

EARTH OBSERVATION CENTER



Eingeweiht am
10. Juli 2010



Jonas Meier, DLR-LFD-LAX



COINS Trip to Ghana

30th of September – 08th of October

Niklas Heiß, Frank Thonfeld, Jonas Meier

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Impact Pathways



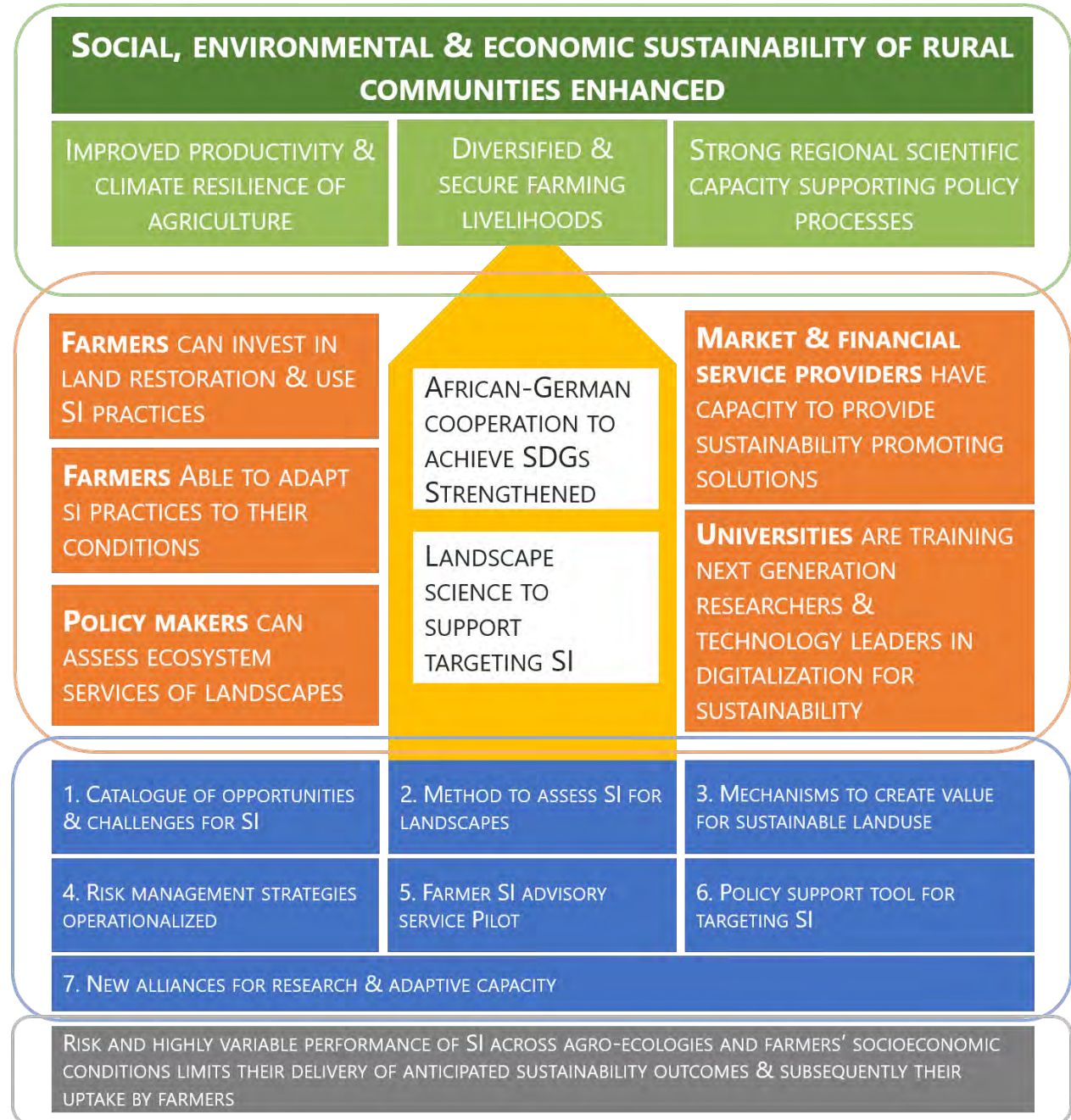
LONG-TERM IMPACTS

MID-TERM IMPACTS

USER OUTCOMES

PROJECT OUTPUTS

CHALLENGE ADDRESSED



Can Insurance Drive Sustainability? Incentivizing Climate-Smart Farming in Northern Ghana

- Understanding of mechanisms behind enabling sustainable land use
 - Insurance as Incentive:
 - Farmers using sustainable practices face lower crop failure risks, making them eligible for reduced insurance premiums or rewards.
 - Barriers:
 - High costs of ISFM inputs and low willingness to pay for insurance remain key obstacles, requiring innovative financing solutions.
 - Next Steps:
 - Scaling adoption depends on trust-building, education, and partnerships with suppliers and institutions to align inputs, insurance, and outreach.



Senegal 2024 | Dakar | Senegal River Valley | St. Louis



SAISON	COLD			DRY			WET			COLD		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MARCO (1 ha) (5.5 tn/ha) (70 bags) (80 kg)												
200,000 ~ 100,000 AF costs 120,000 (in 2022 450,000)												
1) Weeding [20] 2) Clearing [10] 3) Tillage [20] 4) Level [10]	5) Manure [10] 6) Fertilizer + Herbicide [10] 7) Fungicide [5] 8) Herbicide + Fungicide [10] Herbicide	9) Irrigation [25] (Housing [1] 10) Pest-spray [5] (Drainage [5] 11) Harvest [25]										

Focus group discussions:

- Farmers
- Traders

Interviews:

- Public authorities
- Insurances
- Banks

Field visits

Field Visit Ghana

30.9. - 8.10.2023

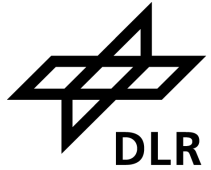


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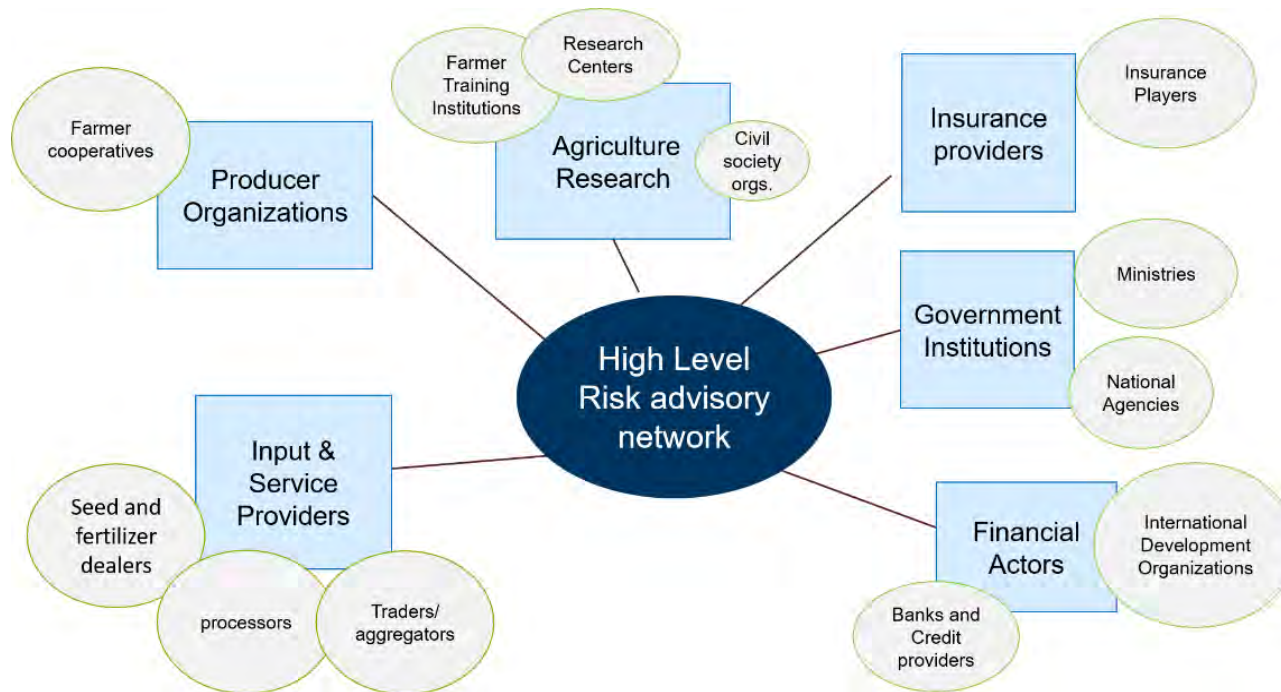
CONCERT



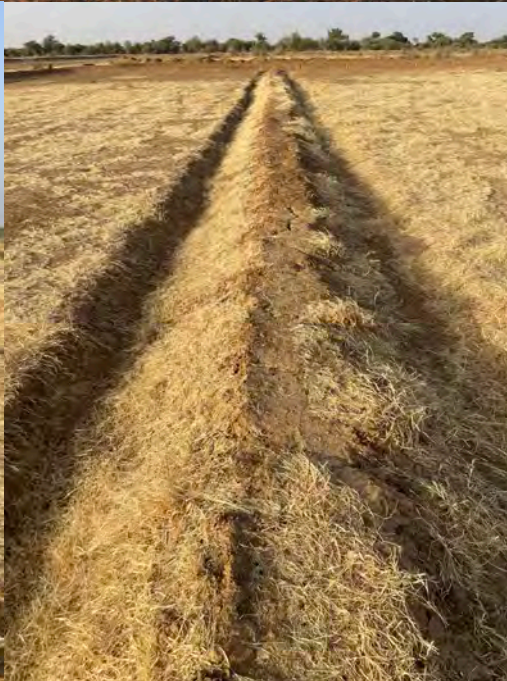
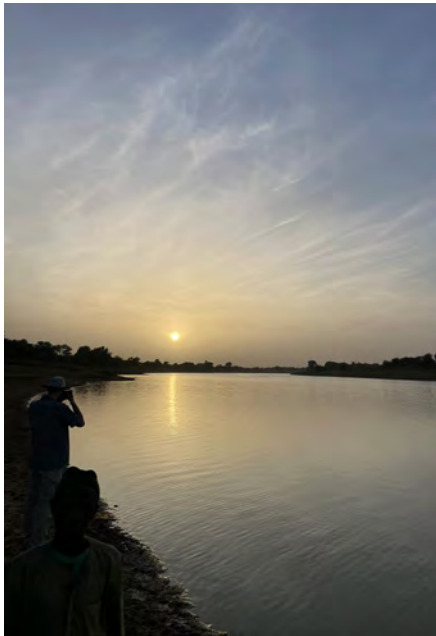
High-Level Risk Advisory Network



Stakeholder Analysis



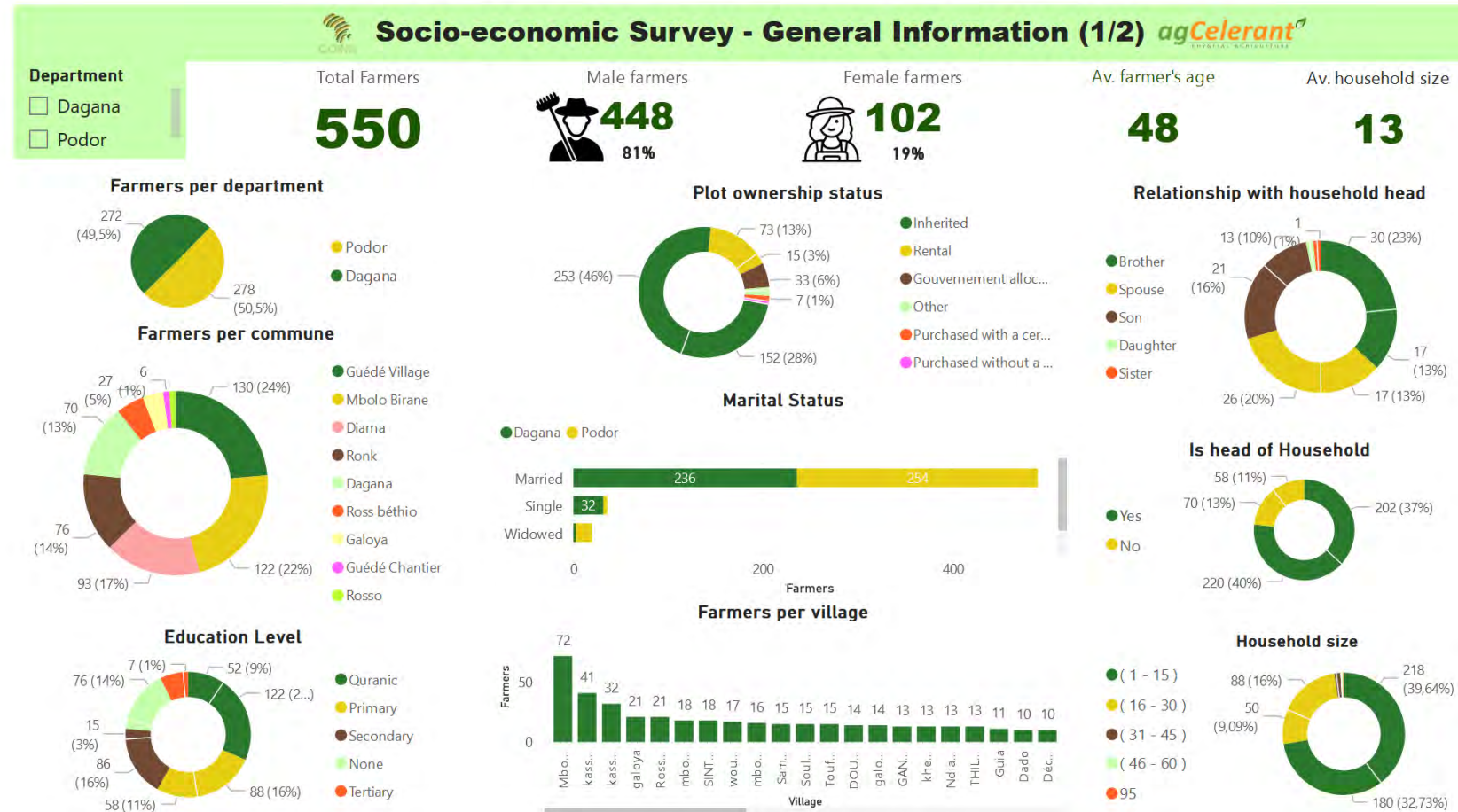
- Mapped key actors: Scientific, political, financial, telecom, research & service providers
- Farmer cooperatives in Senegal & Ghana
- Interviews with stakeholders (e.g. UNU-INRA, ACRE Africa, IPAR, SARI, UN Bonn ZALF)
- Identified gaps, challenges, and synergies
- Upcoming Ghana field trip (2025) to deepen operational insights



Socio-economic survey Senegal 2023



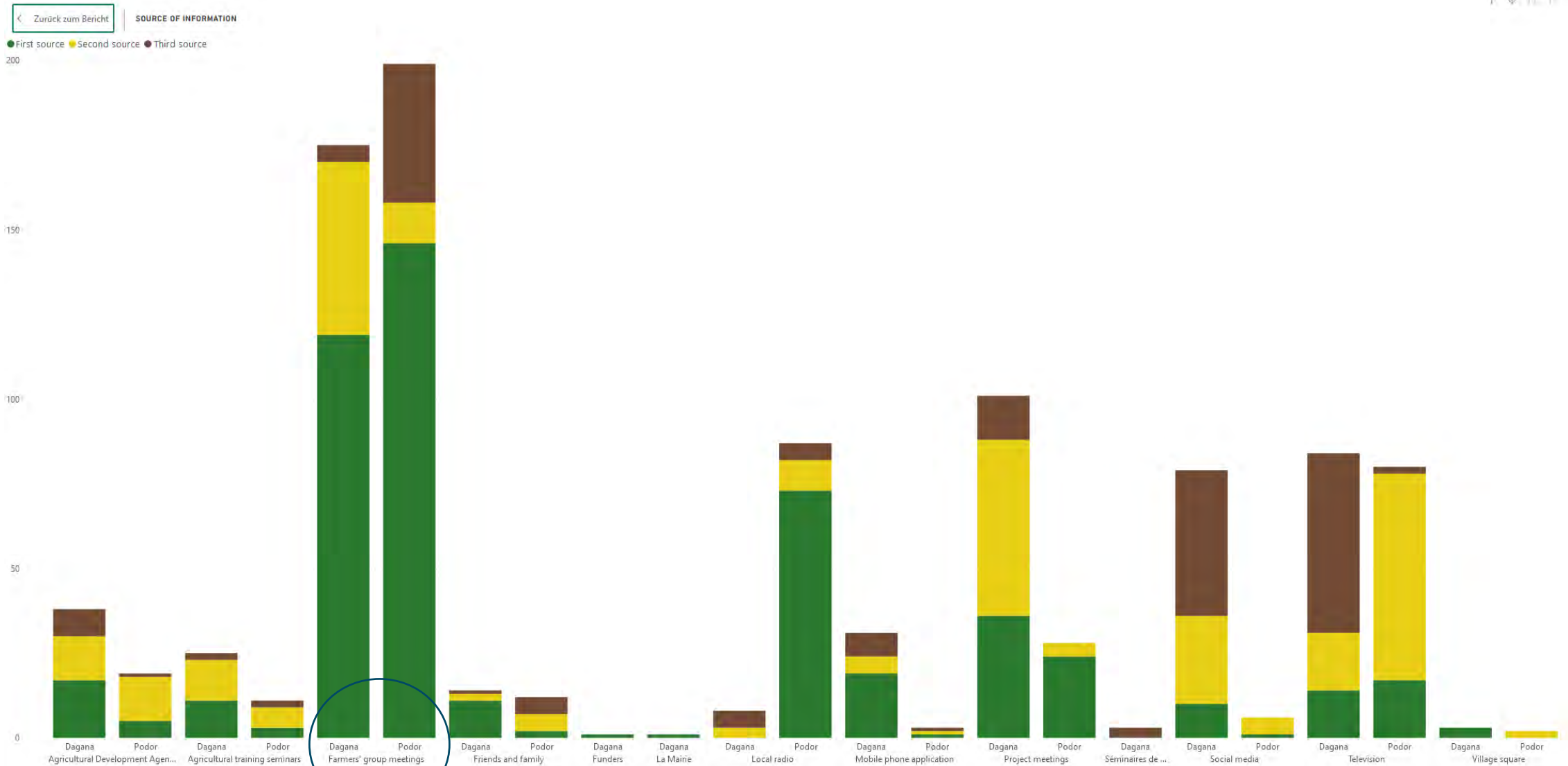
- General information
- Motivation for innovation
- Risks and threats
- Finance
- Support and advisory services
- SLM
- SRI
- Training and adoption of SRI



Access data [dashboard](#):



Socio-economic Survey Senegal 2023



Senegal Trip | COINS

30.1.2024 – 10.2.2024

Jonas Meier, Frank Thonfeld, Niklas Heiß



Study Regions

Northern Ghana:

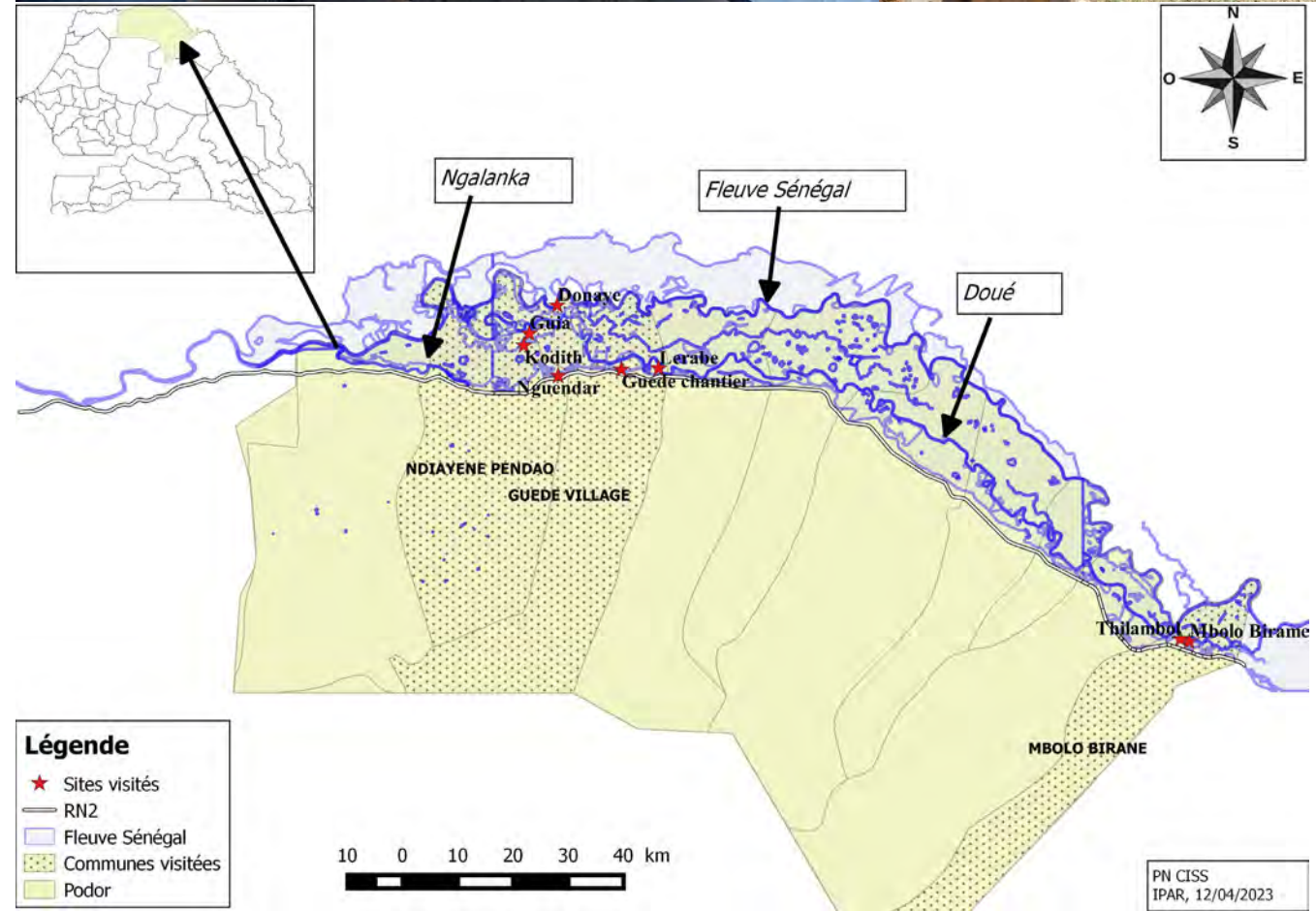
- **Staple crops:** maize, rice, groundnut, cowpea
- **Cash crops:** soybean, shea, groundnut, cowpea
- **Conditions:**
 - Traditional rain-fed production systems
 - Highly erratic rainfall characteristics and changing precipitation patterns
 - Heavily degraded soils
 - Agriculture is the mainstay of the people
 - Poorly organized market arrangements for producers
- **Focus on:**
 - **Integrated soil fertility management (ISFM)**



Study Regions

Senegal River Valley:

- Region Saint-Louis, Départements Podor & Dagana
- Focus on systems of rice intensification (SRI)
- increasing support for rice production sovereignty but decrease of yields
- 1-2 cropping cycles per year
- 2nd basin of migration in
- Strong W-E gradient in sense of degradation, access to labor, markets



Study Regions

Senegal River Valley:

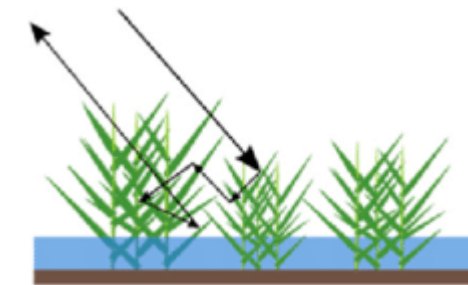
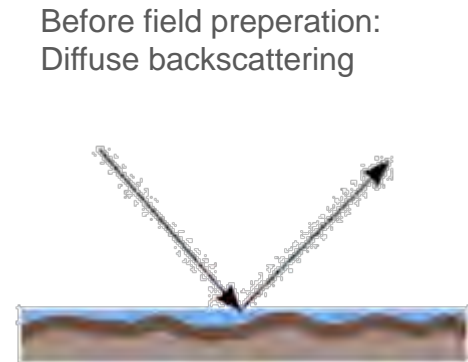
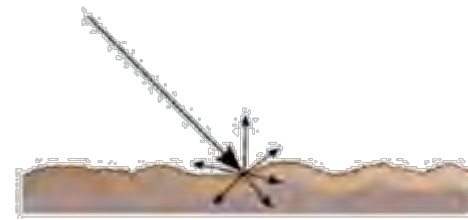
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Identification of Agricultural Management Events

Preliminary results:

- Evaluation of the potential using Sentinel-1 data to identify agricultural management:
 - Tilling
 - Sowing
 - Flooding
 - Harvesting
- Management on field level
- Change detection as indicator for management actions
- SAR-based change detection
- Based on the *Sequential Omnibus Algorithm* (Canty, M., 2019)
- Validation of the management measures actually applied in progress



Modified after Ottinger & Künzer (2020)

