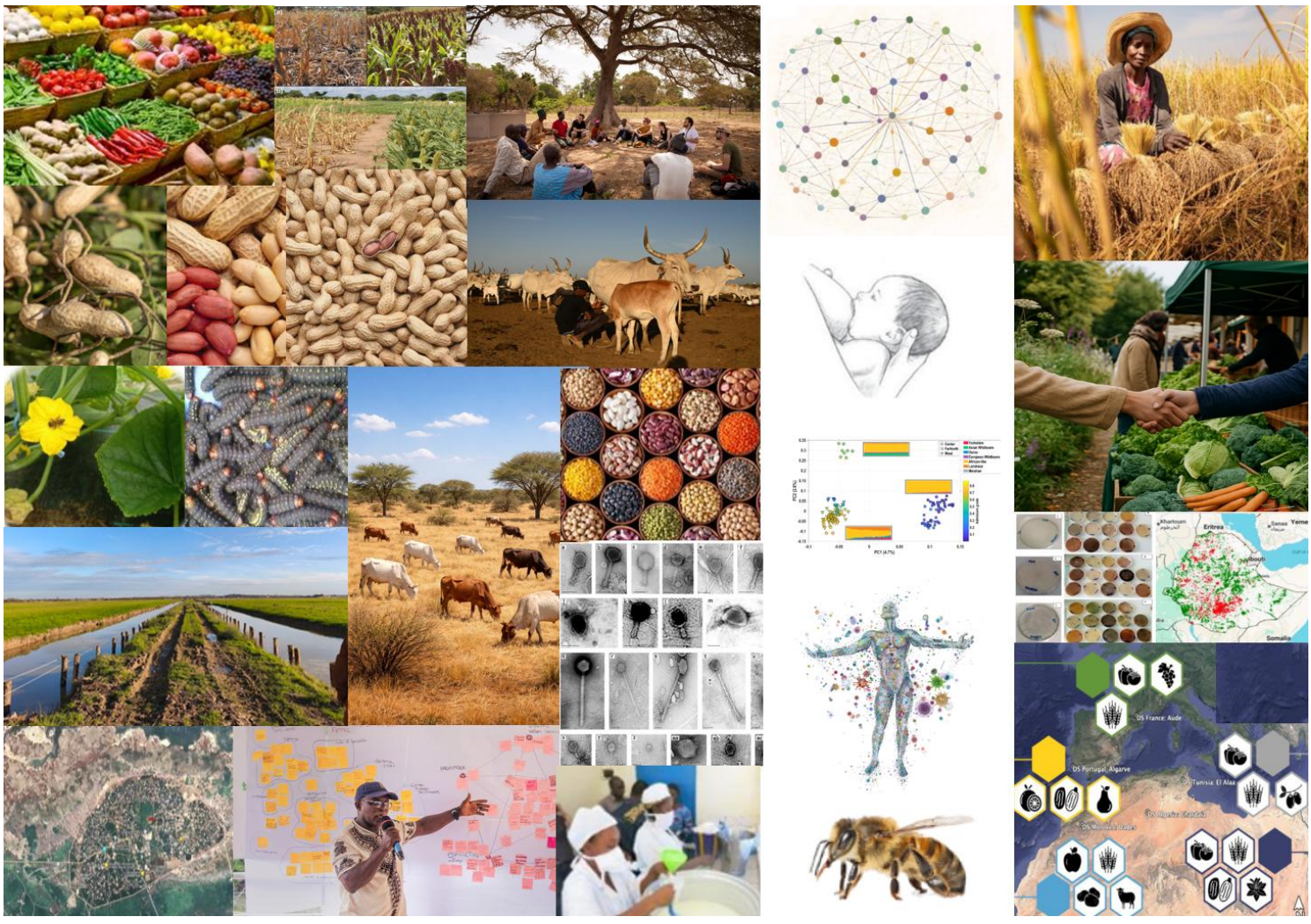
1ST TSARA SCIENCE DAYS

January, 13 – 22, 2026

Agroecology and sustainable food systems
Agroécologie et systèmes alimentaires durables

PROCEEDINGS/ACTES



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ACKNOWLEDGEMENTS / REMERCIEMENTS

To the session chairs and co-chairs / Aux président(e)s et co-président(e)s de sessions :

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I. INTRODUCTIONS, SYNTHESES & CONCLUSIONS (English)

SUMMARY

TSARA is a collaborative research initiative which, through networking, the sharing of knowledge and practices, and the co-development of projects, aims to support the transition towards productive, resilient, sustainable and inclusive food systems, contributing to food and nutritional security and to the creation of value and jobs, whilst preserving resources and global health.

With this in mind, the 1st TSARA Science Days held virtually in January 2026, aimed to: i) share knowledge on agroecological transition, sustainable food systems and the interactions between agroecology and food systems; (ii) foster dialogue among researchers based on their concrete work, and strengthen and open up of the TSARA scientific community; and iii) identify and discuss avenues for further work.

The event brought together over 400 participants, including 71 project leaders, PhD students and senior researchers from Africa and Europe, working across a wide range of disciplines and themes.

Participants, authors and experts agreed on the approaches to be developed and the levers to be promoted in order to achieve the targeted impact.

Agroecology, a systemic approach combining a range of agricultural practices but also a subject of local governance, is regarded as an **effective lever for transforming food systems**: the promotion of local knowledge, collective action and the co-development of strategies tailored to the local area, environmentally friendly production practices, the efficient use of resources, the strengthening of resilience, the improvement of social equity, short supply chains and the promotion of local produce, the steering of consumption patterns, the strengthening of local autonomy and the relocalisation of supply chains.

A variety of agroecological practices are presented - animal and plant genetic diversity, diversification of production and activities, soil, plant and animal health, biological control and biocontrol, pastoralism, water management, circularity, etc. - from the perspectives of modelling, epidemiology, genetics, etc. Climate change and climate variability are explored in the majority of the studies presented.

In the field of food systems, the exhibition showcases innovations, practices, technologies, products, processes, strategies and policies that contribute to improving food and nutritional security: the processing of plant and animal products, including pulses and edible insects; fermentation; freezing; infant nutrition; post-harvest technologies; the cold chain; market development; water management, trade and the interconnections between food, water and energy.

To effectively support the transition towards sustainable food systems, various levers must be activated and coordinated:

- **multistakeholder governance** capable of collaboratively shaping pathways at the local level in an inclusive manner, linking producers and consumers;

- **participatory knowledge ecosystems** bringing together research, training, practitioners on the ground and public institutions, linking local knowledge with scientific knowledge; research can play a role in informing choices and acting as a mediator;

- **in-depth scientific research** into the principles and performance of agroecology, risk-sharing mechanisms, multidimensional and multidisciplinary approaches to food and the trade-offs between these dimensions (culture, economy, environment, short and long terms, gender), the link between

agrobiodiversity, nutrition and the microbiome, and the interfaces between participatory approaches and modelling tools to support decision-making processes, as well as appropriate digital technologies and data;

- **fostering dialogue and science-policy interfaces** to support coherent, coordinated and favourable policies;

- **strengthening training -** both initial and continuing - **for all stakeholders** in agroecology, systems thinking, the interrelationship between food, nutrition and the environment, and appropriate multi-criteria systems.

TSARA is committed to embracing these priorities. As a 'research community, platform and hub of knowledge and expertise', TSARA must, through networking and in synergy with existing initiatives:

- consolidate its **participatory research** approach, **which is both comprehensive and locally rooted**, drawing on living labs;

- develop **training** initiatives, student engagement and support;

- **synthesise its findings, communicate** them, and disseminate them to a wider audience;

- focus on **the science-policy interface** at various levels, particularly within the framework of the African Union-European Union dialogue, in relation to African governments and multinational partners;

- help to **convince decision-makers and the private sector** of the importance of supporting research and securing **funding**;

- continue and expand the provision of **spaces for scientific exchange and interaction**.

The outcome of this first edition of the TSARA Science Days is positive in terms of i) mobilisation and partnership dynamics (teamwork, significant and diverse participation, mutual understanding and strengthening of the TSARA community, and a commitment to continue), ii) format and organisation, iii) content (thematic and disciplinary diversity, richness, interest and practical relevance of the work presented, particularly regarding agroecology, less concerning the interaction between agroecology and food systems). Areas identified for improvement include the high density of sessions, time management pressures and the limited space for discussion.

The expected follow-up actions focus on consolidating communities of practice, developing new collaborations between authors, building networks - particularly amongst PhD students -, organising thematic exchanges, and promoting the content (publications, working groups, training courses).

The upcoming Science Days are widely supported: held in-person (or in a hybrid format) over several days, facilitating in-depth interaction and discussion with opportunities to share experiences, take part in project-based workshops and organise award ceremonies; aimed at a multistakeholder audience – public and private sector researchers, students, farmers, civil society, decision-makers and donors – covering topics such as climate change adaptation, digital agriculture, agricultural employment, biodiversity conservation, water management/ReUSE, *One Health* for food security, and the evaluation of public policies.

1. INTRODUCTIONS

1.1. OBJECTIVES, STRUCTURE & PARTICIPANTS

Chair of Session 1:
Sonia Bedhiaf-Romdhani, INRAT, Tunisia



i) Objectives

The TSARA initiative is strengthened by its collective scientific agenda (approved by the General Assembly in 2024), but also and above all by the collaborative research carried out on the various thematic areas, which feed into the shared objective of TSARA members of "**transforming food systems and agriculture**" with new knowledge, analytical frameworks, methods, and transformative innovations.

In proposing the first TSARA Science Days (via videoconference), the initiative's secretariat[1] has three objectives: i) **to promote dialogue between researchers on the basis of their concrete research**, whether it is part of targeted or large-scale projects; ii) to summarize where we are in the implementation of the agenda, **to clarify together what TSARA research actually is** and how it fits into the landscape, to identify the gaps on which we should focus our attention in the future, and to identify prospects in terms of research, actions, and projects to be carried out; iii) **to consolidate and open up the TSARA scientific community**, raising the profile of its work both within and beyond the world of international research. The Science Days are a unique opportunity to consolidate the "science" aspect of the initiative, both internally and externally, beyond the portfolio of actions and projects.

The secretariat, supported by a steering committee and a scientific committee, has decided to focus this first edition of Science Days on three themes: **agroecological transition, sustainable food systems, and agroecology-food system interactions**.

Behind **the agroecological transition**, the aim is to bring together and facilitate dialogue between research projects that promote the implementation of **agroecological principles**, such as research on the **barriers and drivers of transition**, soil functionality, input reduction, diversification of activities and the integration of forestry, crops, and livestock, water conservation, plant, animal, and environmental health, knowledge co-production, development of local food systems, job creation, digital transformations, etc.

Sustainable food systems can be addressed, for example, through research on the valorization of **local resources** and the **reduction of losses and waste**, the study of the relationship between food and human **health**, **market** differentiation and the distribution of added value in value chains, **job** creation, the role and methods of **agri-food processing**, **digital** transformations, food system **governance**, etc.

[1] TSARA's governance is ensured by: (i) a General Assembly (GA) comprising the directors-general of the member institutions; (ii) a secretariat which implements the GA's decisions and oversees activities relating to science, projects, partnerships, governance and communication; (iii) 9 thematic task forces -TTF-, groups of scientists who form the backbone of TSARA, and iv) an external advisory committee (EAC).

Contributions that establish **a link between the principles of agroecology** (soil health, biodiversity, recycling, input reduction, connectivity, etc.), the **functioning of food systems** (production, processing, losses, environment, consumer behavior, value chains, etc.), and the outcomes of food systems (environmental and socio-economic sustainability, food security, nutrition, and health) are also welcome and taken into account.

ii) Overview

These 1st Science Days therefore focus on collaborative research that contributes to agroecological transitions, the sustainability of food systems, and that examines the interactions between agroecology and food systems.

Sessions 1 to 3 on 13, 15 and 20 January (**Agroecological transition, Sustainable food systems, Interactions between these two approaches**) were structured as follows:

i) **doctoral students establish the "landscape"** in which TSARA fits in relation to the session topic, in an interactive manner with participants;

ii) **presentation of projects carried out within the framework of TSARA and/or in connection with TSARA**, in response to a call for papers; the proposals received are numerous and diverse in terms of themes, approaches and scope; they are presented in two parallel sub-sessions;

iii) **summary and outlook**.

Session 4 on 22 January is devoted to a summary of the previous three sessions, a participatory discussion of this summary and **a perspective through two round tables aimed at identifying directions and avenues for research, actions and projects to be carried out**.

iii) Participants: authors and the public

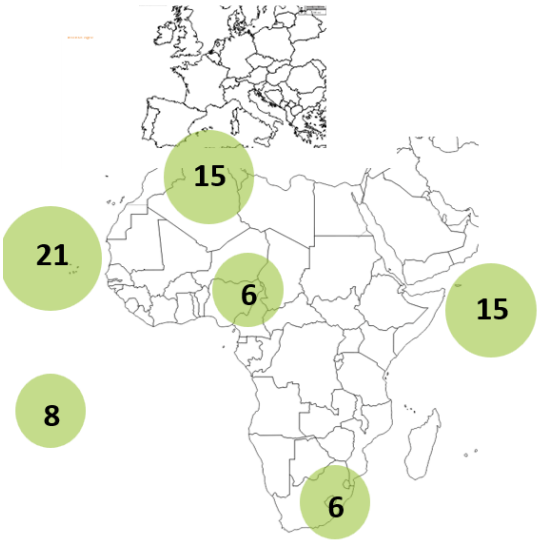
Following the call for papers, **71 proposals** were selected by the scientific committee and allocated to 10-minute or 5-minute presentations, or poster presentations.

Chair of the Scientific Committee:

Benoît Dedieu, INRAE, France



Research is being carried out in numerous countries across West, East, Southern and Central Africa, as well as on a continent-wide scale, and covers a wide variety of topics.





Regarding participants:

- a **total of 424 participants** (unique individuals who joined one or more sessions)

- from **43 countries, including African and European nations, as well as countries in Latin America, North America and Asia**

  - More than 20 participants: France, Morocco, Senegal

  - Between 10 and 20 participants: Benin, Ethiopia, Tunisia, Cameroon, Burkina Faso, Côte d'Ivoire, Madagascar

  - Between 9 and 2 participants: Kenya, Mali, South Africa, the Democratic Republic of the Congo, Ghana, Togo, Algeria, Canada, Nigeria, Zimbabwe, Italy, the Netherlands, Chad, Uruguay, Germany, Guinea, Namibia, Uganda, Zambia

  - 1 participant: Bolivia, Brazil, Comoros, Congo-Brazzaville, Denmark, India, Romania, Slovenia, Sudan, Sweden, Tanzania, United Kingdom, United States, Vietnam

- and **180 institutions, 75% of which are research or training organisations**; ministries, international organisations, NGOs, the private sector and producer organisations are also represented:

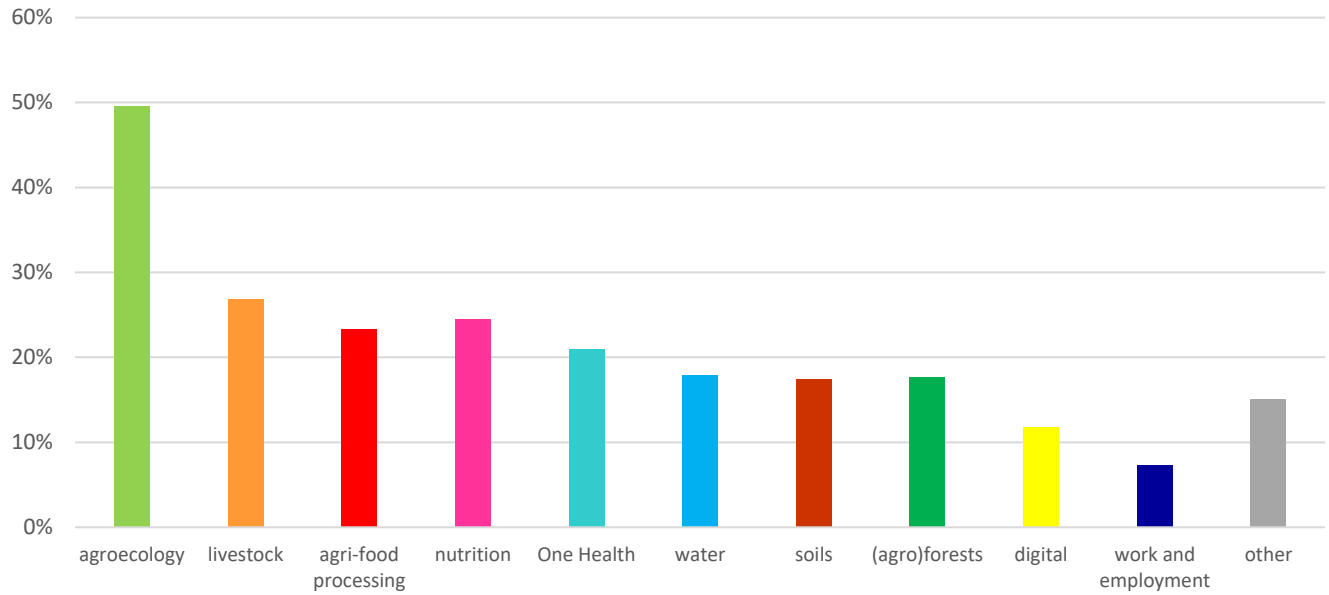


In terms of **attendance at the various sessions:**

- **13%** of participants attended all **four sessions**, 14 per cent attended three sessions, 28 per cent attended two sessions, and **46% attended one session**;

- the sessions each attracted the following numbers of participants: **245** (session 1), 219 (session 2), 179 (session 3) and **176** (session 4).

▪ **Agroecology** was cited by 50% of participants as a topic of work (not exclusive); all the topics at the heart of the scientific agenda were mentioned (percentage of participants citing each topic):



1.2. OPENING

Jean-Paul Laclau, DGDRS - Deputy Directorate-General for Research and Strategy, CIRAD, France, representing the CEO and co-chair of TSARA



Thank you for inviting me to open the TSARA 1st Science Days. I am here representing Cirad's Director-General, Elisabeth Claverie de Saint-Martin, who currently holds the rotating co-presidency of the initiative alongside the Director of ENA Meknès, Professor Saïd Amiri, who will bring this scientific conference to a close.

1. My thanks to the many organisers. The main aim of this event is to strengthen the scientific community involved in the TSARA initiative.

These scientific days were conceived at TSARA's second General Assembly in Senegal in 2024, formally decided upon at the third General Assembly in France in 2025, and will be highlighted at the General Assembly in Nairobi next May. All TSARA members supported the launch of the Science Days at these General Assemblies.

Around fifty people from various countries have been heavily involved in organising these days, whether within the TSARA secretariat, the scientific committee, the steering committee for the events, or in reviewing the numerous proposals for papers.

2. Our thanks go to all the speakers and participants who submitted paper proposals, who are chairing sessions, who are acting as key speakers, and, of course, to everyone attending these days.

Participation in this conference has been a resounding success, with over 80 speakers and around 650 registered attendees from 65 countries and more than 300 institutions. Whilst many papers focus on agroecology, participants are taking an interest in all of TSARA's thematic areas.

3. TSARA aims to support public policy whilst contributing to major international initiatives that bring together Africa, Europe and other continents in the fields of agriculture, food and the environment.

TSARA is a collaborative consortium for research, training and innovation, designed to share knowledge, methods and networks, and to jointly develop research programmes and projects.

4. Cirad is heavily involved in TSARA. This initiative contributes to our scientific and partnership-based strategy for the transformation of food systems. The themes selected for the four sessions of this event, centred on the sustainability of food systems and agroecological transitions, lie at the heart of our commitments to our partners. Cirad shares all of TSARA's objectives. It is particularly important to us that the initiative's members share a common vision of the key socio-economic and environmental challenges and their implications for agricultural research.

These days promise to be particularly packed and interesting. I wish you fruitful discussions so that they may fully achieve their objective of consolidating the TSARA scientific community.

Thank you.

1.3. THE TSARA INITIATIVE

Marie Schill, TSARA project leader at INRAE, France



i) TSARA: what is it for?



TSARA operates against a backdrop of global challenges – particularly acute in Africa – such as population growth, climate change and limited resources. This requires finding and achieving a form of **performance that is at once economic, environmental and social**; creating value and jobs, make the most of local resources, and to focus in particular on the circular economy to **do more with less**.

This is a highly complex task that requires the **mobilisation of research**.

Research:

- which enables the **co-construction of knowledge to understand and characterise our systems**, in order to find solutions;
- which focuses in particular on **interfaces** and **nexuses**, drawing on numerous **disciplines** and operating through **synergy** and **complementarity** – key concepts within TSARA;
- which operates within a **balanced partnership** designed to reduce the existing asymmetry of resources between continents and our countries;
- that pays particular attention to **young people as future stakeholders**, notably through **training**.

ii) TSARA, a partnership

TSARA has 36 members from 17 countries, spread across the African continent and in Europe – currently in France.



[In October 2026, TSARA had 39 members, with the University of Nairobi in Kenya, USSEIN – Sine Saloum El-Hâdj Ibrahima NIASS University – in Senegal, and UASZ – Assane Seck Ziguinchor University – in Senegal having joined the initiative].

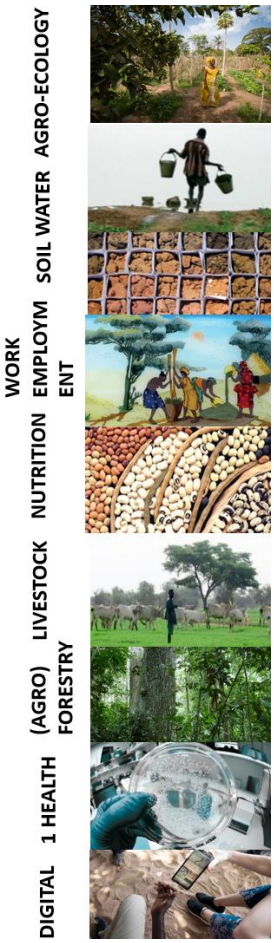
iii) TSARA: a continuum of research, projects, partnerships and decision-making

TSARA provides a framework for **scientific reflection and exchange**, which takes concrete form through **projects** that mobilise partners and networks and may even engage with public authorities as a form of scientific diplomacy.









TSARA currently comprises **more than 70 co-funded activities**, including PhD **theses, scientific events and collaborative research projects**. These activities cover a wide range of topics related to TSARA's scientific agenda, which comprises nine often-interconnected themes – agroecology, water, soils, (agro)forests, livestock farming, nutrition, One Health, labour and digital technology – and employ a wide variety of methods, with genetics and modelling playing a particularly significant role in relation to climate change.

iv) Some examples of clusters that are both unifying and operational

On the key issue **of labour and employment**, linked to the crucial question of youth, the international conference held in Dakar in January 2025 highlighted a **strong need for data to inform policies that are genuinely effective in promoting decent work**, and this issue is receiving sustained attention from the Senegalese authorities.



EMPLOYAE

Dakar International Conference on the future of work and employment in the agricultural and agri-food sector in West Africa **(01/25)**

Policy paper: decent work

Outlook: attractiveness / innovation

Young people
Public policy

⇨ *Supporting the production of **data** on work and employment according to agricultural models in order to inform **policies that are genuinely conducive to decent and attractive jobs.***

In **the fields of food systems, nutrition and processing**, there are numerous examples, ranging **from the microbiome to public policy**, covering topics such as cold **storage**, **markets** and particularly prominent sectors such as **pulses**.

FOOD SYSTEMS
NUTRITION - TRANSFORMATION



FAMA - food and microbiota in Africa
Numiscol
Traditional **fermented** fish products

Selection of peanuts - amino acids
Pulses and **infant** flours
Local plants and lactation

Milk as a vector for development
MIPCLAN - **livestock** and greenhouse gases

AFRICOLD - low-cost **refrigeration**

Local markets - organic/agroecology intermediation
Food & migration

Health
Local
Value creation
Energy

In the areas of **triple performance**, **agroecology** and the **One Health** approach, projects focus, for example, on bees, drawing on epidemiology, modelling and genetics.

OH/health territories, plants, animals/ pollinators, alternatives to pesticides



Bees and AE

MARA - **modelling**, pests, agroecology
Cowpea - epidemiology of cowpea bacterial blight
Ghanagref - rootstocks, **selection**, resistance to tomato diseases
Diagnet - rice disease diagnosis
Ectoparasites - integrated cattle health management
Phenoticks - new tick resistance **phenotype**

Local breeds and resilience - 3 webinars - **CBBP**

Triple performance
Agroecology
One Health

The issue of **water – from quantitative and qualitative perspectives, and in terms of reuse** in connection with the growing theme of **circularity** and its link to **digital technology** – is also a key focus, often drawing on approaches characteristic of TSARA, such **as multi-stakeholder engagement and living labs**.



MORFeus - nexus solutions **water-energy-food-ecosystems** for resilient Mediterranean territories
AQUEDUCT - hydrological interconnection in Mediterranean catchment areas
MAHDIA - nexus between water, food and WT

ReUSE - optimisation using digital tools

Nexus
Living labs
Circularity
More with less

v) Exchanging ideas, sharing and moving forward together

TSARA then finds its strategic purpose through opportunities for exchange and dialogue, in various formats, at different levels and on different scales; here are three examples.

Putting people at the centre, meeting each other in our diversity







A scientific format unique to TSARA: the **Inter-TTF** (Thematic Task Forces) **Seminar**, held in December 2024 at the ENA in Meknès, Morocco, where we discussed the concept of 'transformative sciences', explored potential synergies between ongoing initiatives, and considered how to set up projects.

An open scientific format, featuring the **first TSARA Science Days.**

A more institutional format, marking a significant milestone for TSARA: our **4th General Assembly, organised in May 2026 in Nairobi as part of the Africa Forward Summit, which will include opportunities** for scientific exchange as well as visits to laboratories and field sites.

Further information on TSARA: brochure and website.

2. SESSION SUMMARIES

2.1. SESSION 1: AGROECOLOGICAL TRANSITION

Chair:
Sonia Bedhiaf-Romdhani, INRAT, Tunisia



Session 1 laid the conceptual foundations, highlighting a widely shared understanding of agroecology as a holistic approach that integrates environmental sustainability, resilience, social equity and food security. Participants emphasised its central role in addressing the climate, ecological and food crises, whilst identifying major scientific challenges, notably scaling up, measuring long-term impacts and bridging the gap between scientific knowledge and local knowledge.

i) Participatory mapping of the 'landscape'

Facilitator:
Khadija Jaafary &
Wiam Moumen, IAV, Morocco





130 people took part in the 'Wooclap' online survey, 60% of whom were men and 40% women. The median age group was 40–54.

- In response to the question: 'In one word, **how would you define agroecology / its main objective?**', there were a great many answers! The most common terms were 'sustainability', followed by 'environment', 'biodiversity' and 'resilience'.

- **What are the main limitations and barriers to the implementation of agroecology in your region?** The most frequently cited responses, in order, were: a lack of training and support (50% of respondents); yields perceived as lower (45%); unfavourable public policies (43%); and technical and economic uncertainties (40%). Increased labour requirements (34%) and a lack of market opportunities (16%) were cited less frequently.

- In your view, **what is the greatest current scientific challenge facing agroecology?** The most frequently selected answers, in order, are: designing suitable multi-criteria systems (44% of voters); measuring long-term performance and impacts (40%); understanding complex ecological interactions (36%); shifting between scales – plot, territory, country/region (36%). The integration of digital tools lags far behind (17%).

- **In agroecology, what is the most difficult trade-off to balance?** The most widely accepted response is, by far, striking a balance between economic viability and environmental responsibility (48% of voters). Next came the balance between productivity and ecosystem conservation (37%) and that between scientific knowledge and farmers' traditional knowledge (34%). Then, short-term results versus long-term sustainability (28%) and, finally, the standardisation of practices versus their adaptation to local contexts (26%).

- In your view, **what are the main training needs in agroecology in your country** (academic training and training for local stakeholders)? Responses were open-ended but organised by continent.

In North Africa, several of the elements mentioned below were identified, such as issues relating to both vocational and continuing professional development, extended to include university-level training, with a practical focus tailored to local climate challenges. The topics identified for further exploration relate to ecosystems, the marketing of produce and short supply chains, the interactions and benefits of integrating crop and livestock farming, good agroecological practices, and water management. It is also necessary to raise public awareness, strengthen interaction between scientists and policy-makers, and, finally, educate stakeholders on the benefits of agroecology.

In Central and East Africa, participants also highlight the lack of training programmes in agroecology, specialised courses and continuing professional development, involving all relevant stakeholders. The challenge with agroecological training is that it concerns farmers (including those involved in advocacy), local stakeholders, and academic programmes aimed at producing qualified experts capable of addressing research challenges, designing experiments, and analysing and interpreting data. The institutional and political dimensions must not be overlooked, nor should the need for financial support. From a more thematic perspective, land restoration is specifically mentioned.

In West Africa, these issues range from vocational to university-level training, open to local stakeholders, as well as the challenge of raising awareness amongst policy-makers. The training of agricultural technicians is frequently mentioned, alongside the need to change the current top-down approach. University education must incorporate contributions from modelling, complexity sciences and transdisciplinary practice. There are numerous areas for further exploration: market access and added value for products; business models; the assessment of health and environmental risks; the promotion of local knowledge; techniques for producing bio-inputs and, more broadly, alternatives to conventional inputs; recycling methods; collaborative decision-making; and the promotion of cooperatives. These ambitions require financial support, which is currently insufficient, as well as targeted grants for farmers committed to the agroecological transition.

In Europe, the aim is to provide training in agroecology at all levels of education and to offer continuing professional development courses for farmers. The development of the skills of advisers and those working in the food sector is also a key issue, as is raising awareness of agroecology amongst local stakeholders and policymakers. Several topics for further exploration are highlighted, such as biodiversity, genetics, soil health, and the behaviour of crops when they deviate from the optimal growth patterns for which they were selected. Above all, however, the aim is to transform the ways in which training, advice and support are provided, through dialogue between experts and farmers, multistakeholder participatory approaches, exchanges between producers, demonstrations of nature-based solutions and visits to farms achieving good results. A pragmatic approach, accepting reality as it is. Holistic and multidisciplinary approaches are necessary, as is the development of assessment tools specific to agroecology.

- Could you share some **examples of networks, initiatives or projects related to agroecology**?

The list of networks and projects mentioned is not included here: there are a great many of them, some international in scope and others local, across the various regions of the African and European continents. The TSARA secretariat has made available to readers a comprehensive list of acronyms, the

details of which (objectives, funding, partnerships, operational procedures, regions involved, deliverables) are not analysed here.

ii) Project presentations

Co-chairs:
Genevieve Dione, ISRA, Senegal
& Nadine Andrieu, CIRAD, France




The projects, carried out as part of TSARA or in connection with TSARA, are detailed in Section II (abstracts and slideshows).

The titles, authors, institutions and scopes are as follows.

Parallel session A – Approach (territories, co-design, living labs, participative, support, governance, policy, scaling) - Genevieve Dione, ISRA, Senegal

Towards food systems transitions through a regional multi-actor research network for agroecology in East Africa (RMRN-EA)	Frank	CHIDAWANYIKA	*icipe*	Kenya et al
Agroecology and sustainable farming in Africa	Cédric	GAUCHEREL	INRAE	Burkina Faso
The SIMPA seminar: a South-North dialogue on participatory approaches in wetlands	Calypso	BEAUCHAMP	INRAE	Maroc, Ouganda, Tunisie
Studying the sustainability of market gardening as a problem of guaranteed viability	Isabelle	ALVAREZ	INRAE	Sénégal
Governance of agroecological transition in Burkina Faso: a critical assessment of public policies for agroecological transition in the dairy sector in Bobo-Dioulasso	Der	DABIRE	CIRDES	Burkina Faso
Mitigation practices for low-carbon livestock in Sub-Saharan Africa: A living lab Approach	Tobi	AKINROPO	INRAE	Nigéria & al
Setting up a Euro-African network on the reuse of treated wastewater	Jérome	HARMAND	INRAE	Tunisie Maroc

Parallel session B - Practices (practices, tools, technologies, process) - Nadine Andrieu

Eco-Climatic Feedbacks of Ethiopia's Green Legacy initiative: a Deep Learning Analysis of Coffee Forests in Maji, Southwestern Ethiopia.	Ambaye	KEBEBA	AAU	Ethiopie
Beekeeping for market gardening and biodiversity in Côte d'Ivoire	Koyo Nzala & Kamila	REMICHE IVALDA & CANALE TABET	INRAE	Côte d'Ivoire
Agroecological management of sheep reproduction in Tunisia: Automated monitoring of the sexual activity of the Black Thibar breed using the Ovimate electronic mounting detector.	Samia	KHNISSI	INRAT	Tunisie
Community breeding programmes: a framework for managing native tropical animal genetic biodiversity: cross-learning between Senegal and Guadeloupe	Younouss	CAMARA	UGB	Sénégal
Rainfall patterns change impacts on agroecological systems in sub-Saharan Africa: the case of maize production and nitrogen use in sub-humid Zimbabwe	Gwenaëlle	LASHERMES	INRAE	Zimbabwe
FrEgARCHAEO (the French-Egypt archaeo-logy/genomic Network)	Jérôme	SALSE	INRAE	Egypte
Local bioresources for the sustainable production of microbial biopesticides: towards an ecological and economic alternative to conventional culture media	André	GADJI	CNRA	Côte d'Ivoire
Assessing Smallholder Farmers' Vulnerability to Extreme Climate Events Across Agroecological Zones in the Sidama Region, Ethiopia	Yoseph	YISEHAKE	Hawassa University	Ethiopie
Biological Indicators and Agroecological Transition: Response of Microarthropods in Two Moroccan Living Labs	Outmane	EL OMRY	ENA Meknès USMBA	Maroc

Posters

Economic potential of agroecological transition	Afaf	SARI	ENA Meknès	Morocco
Running a farm in uncertain times: a mathematical investigation on the shores of Lake Guiers	Dame	THIAW	CIRAD	Senegal
Presentation of EPITAG 'EPIdemiological modelling and control for Tropical AGriculture', a Franco-Cameroonian partnership	Suzanne	TOUZEAU	INRAE	Cameroon
AI-based insecticide resistance prediction	Kiwoong	NAM	INRAE	
Interactions between companion trees and cocoa trees and the dynamics of soil acidity in cocoa agroforestry systems in Côte d'Ivoire	Emile	BOLOU BI Bolou	INPHB	Côte d'Ivoire

iii) Summary of presentations and outlook

Parallel Session A: Agroecological transition approaches – Geneviève Dione

Parallel Session A, devoted to agroecological transition approaches, featured seven presentations delivered by researchers and practitioners working in various African and Euro-African contexts. The presentations were organised into two successive sessions, combining 10-minute and 5-minute talks, each followed by a group question-and-answer session.

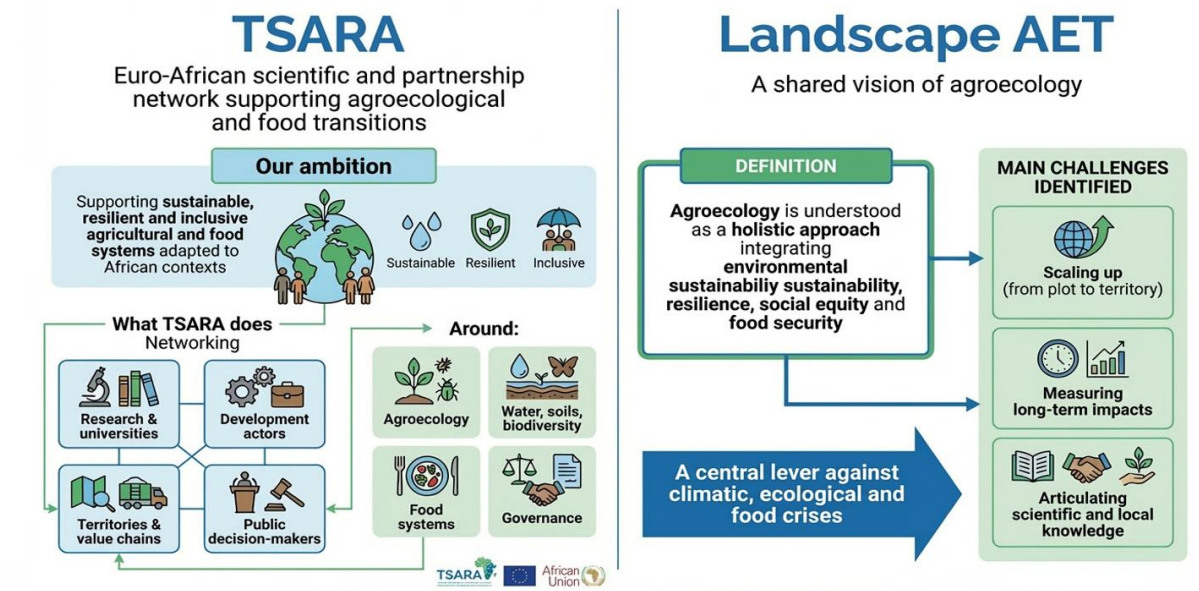
The presented papers approached the agroecological transition not as an homogeneous set of practices to be disseminated, but as a complex, context-specific and multi-stakeholder process, mobilising a variety of research, support and territorial governance mechanisms.

An initial set of contributions focused on the role of networks, training schemes and knowledge-sharing mechanisms in shaping the transition. The projects presented – particularly those centred on regional agroecology networks, multi-stakeholder living labs and scientific dialogue mechanisms – demonstrate that the transition is advancing less through technology transfer than through the construction of knowledge ecosystems bringing together research, training, practitioners on the ground and public institutions. These approaches highlight the specific role of research as a structuring and capacity-building force, whilst repeatedly raising the question of the sustainability of these dynamics beyond the scope of individual projects.

A second set of presentations addressed the agroecological transition from the perspective of resource and territorial governance issues, particularly concerning water, agricultural supply chains and productive infrastructure. Research carried out on market gardening in the Niayes, the dairy sector in Burkina Faso and water management shows that the main barriers to the transition are rarely technical in nature. They are linked to rules governing access to resources, existing institutional frameworks, collective decision-making and power relations. In these contexts, research plays a mediating role, providing socio-institutional analysis and prompting debate on the rules, thereby helping to highlight the scope for possible transformation. These projects serve as a reminder that without appropriate governance mechanisms, the agroecological transition remains fragile, and may even be reversible.

A third set of contributions focused on exploring possible transition pathways, notably through approaches to modelling socio-ecological, agricultural and pastoral systems. This work is not intended to predict the future or prescribe solutions, but rather to inform collective decision-making by highlighting the trade-offs, possible divergences and structural limitations of certain scenarios. It does, however, highlight a key challenge: that of translating these analytical tools into real-world decision-making contexts, without simplifying the social and ecological complexity they reveal.

Taken as a whole, the projects presented show that the agroecological transition is taking shape at the interface between research, action and governance, with science playing distinct roles: structuring collectives, supporting processes, equipping stakeholders, informing choices and stimulating debate. They also highlight that research cannot replace political choices or local compromises, but that it can help to open up possibilities and shed light on pathways to transformation.



Outlook for TSARA

- Strengthen the links between research networks, training programmes and public institutions in order to ensure the sustainability of transition initiatives.
- Fully recognise the agroecological transition as a matter of local governance and not merely as a set of agricultural practices.
- Develop closer links between participatory approaches and modelling tools to better support decision-making processes.
- Continue and expand opportunities for scientific and multi-stakeholder exchange, such as TSARA's Science Days, to consolidate a community of practice around agroecological transitions.

Parallel Session B: Agroecological Practices – Nadine Andrieu, with Benoît Dedieu, INRAE

Key messages

A variety of agroecological practices explored within the TSARA community:

- genetic diversity (animal and plant)
- biodiversity (pollinating insects)
- agroforestry
- utilisation of crop residues
- biological control
- diversification of productive activities.

Referring to the **13 principles of agroecology** set out in the HLPE report[2] , it is clear that each of the studies draws on **one to three of these principles**. The principles most frequently cited in the studies are:

- reduction in pesticide use

[2] Report No. 14 of the HLPE – High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security – published in 2019 on 'Agroecological and other innovative approaches for sustainable agriculture and food systems to improve food security and nutrition'.

- harnessing biodiversity
- diversification
- recycling
- soil and animal health.

Climate change and variability are explored in the majority of the studies presented.

Outlook for TSARA:

- to explain more clearly **the** agroecological **principles** explored in the research
- endeavour in each study to address a greater number of agroecological principles
- integrate **biophysical principles** with **socio-economic principles** in this research.

2.2. SESSION 2: SUSTAINABLE FOOD SYSTEMS

Chair:
Mohamed Taher Sraïri, IAV, Morocco



Session 2 explored the operational and systemic challenges of sustainable food systems in greater depth. The findings show that the main problems to be addressed relate to inequalities in access to food, a lack of coherence in public policies, dependence on imports and the nutritional quality of diets. The priorities identified focus on strengthening the resilience of food systems, reducing environmental impacts, improving nutrition and developing short supply chains linking producers and consumers.

i) Participatory mapping of the 'landscape'

Facilitator:
Wiam Moumen, IAV, Morocco &
Zeine Zein Taleb, ENAM, Morocco





Depending on the question, between 89 and 95 people took part in the online survey, of whom 52% were women and 49% were men. The majority of respondents were relatively young, with 40% aged under 39. The questions and answers are set out below.

- In three words, what terms spring to mind when you hear the phrase 'sustainable food system'?

222 words, presented as a word cloud by the Wooclap app (the colours are used for clarity but do not correspond to the meaning of the words).



'Resilience' is in the centre, making it the most frequently cited term, but 'food security' and 'security' would certainly be in the centre if there were only one language. Similarly, 'environment' appears in large letters and close to the centre, in both French and English ('environment'). 'Health' and 'healthy' feature more prominently than 'santé', perhaps reflecting the fact that the English-speaking members of the group are more attuned to this aspect than the French-speaking members.

Less frequent words such as 'nourishing', 'cooking', 'food', 'diversity', 'diet', 'food environment', 'quality', 'food safety', 'healthy eating', can be linked to the broad group 'nutrition/health'; 'accessibility' to 'food security'; *'resource* boundaries' to 'Environment', …

Thus, at the core – and without being able to truly rank them in order of importance – we have:

Food security, Resilience, Environment, and Nutrition/Health.

Around these terms, other concepts emerge which can be grouped, for example, as follows (translating from English to French):

- 'Agroecology', 'agriculture', 'local seeds and breeds', 'food availability', 'sustainable raw materials'
- 'Territory(ies)', 'local', 'sovereignty', 'food autonomy'
- 'Circularity', 'recycling', 'less waste'
- 'Food industry', 'processing', 'traceability', 'distribution of value along the value chain', 'value chain'
- 'Ethics', 'respect', 'future generations', 'inclusivity', 'equity', 'socially just', 'social justice', 'right to food', 'fair', 'people-centred'
- 'Choice', 'governance'
- Climate change (mentioned once) stands somewhat apart.

Thus, words relating to production, processing, waste management, as well as the locations where these activities take place (territory), and the associated decisions (choice, governance) and values (equity) appear less prominently.

- In your view, which objective should be a priority in the implementation of sustainable food systems? 89 respondents, multiple choices from a list.

Priority objective(s)	Number of responses	% of respondents
Strengthening the resilience of food systems	44	49%
Ensuring food security	37	42%
Minimising environmental impacts	34	38%
Reducing social inequalities	30	34%
Ensuring affordability	26	29%
Improving the nutritional quality of food	25	28%
Strengthening the producer-consumer link and developing short supply chains	21	24

Ensuring food security – with affordability considered its central pillar – appears to be the top priority for sustainable food systems, followed by building resilience and minimising environmental impacts.

- In your view, what is currently the main problem that needs to be resolved to ensure a successful transition to sustainable food systems? 95 respondents, multiple choices allowed.

Identified challenge	Number of mentions	Frequency (% of respondents)
Poor distribution and inequalities in access to food	50	53%

Lack of consistency and coordination in public policies	47	49
Excessive reliance on imports	32	34%
Excessive environmental impacts	23	24
Insufficient nutritional quality	18	19 %
Insufficient food production	12	13

'Poor distribution and inequalities in access' were cited by more than half of respondents (53%). 'A lack of coherence and coordination in public policies' was also frequently cited (49%). It is interesting to note that insufficient food production was the least frequently cited option, with only 13% of respondents mentioning it.

- In your context, what is the most urgent lever to activate in order to transform the food system?
91 respondents, multiple choices allowed.

Area for action	Number of mentions	Frequency (%)
Relocalising and restructuring food supply chains (food sovereignty, territorialisation)	56	62%
Reorienting public policies and agricultural subsidies	33	36 %
Changing dietary patterns and eating habits	29	32
Tackling food loss and waste	28	31
Strengthening regulation of private sector players and limiting the influence of lobbies	24	26

The lever relating to 'food sovereignty, territorialisation, relocalisation and the structuring of food supply chains' was cited by a very large majority of respondents (62%). The lever concerning 'the reorientation of public policies and agricultural subsidies' came in second place, whilst the one aimed at 'strengthening the regulation of private actors and limiting the influence of lobbies' came last.

- In your view, what are the main gaps or needs today in terms of training on sustainable food systems?

120 responses; the proposals are grouped by broad themes. The report does not provide an exhaustive breakdown by theme or region to allow for a reliable quantitative ranking.

Theme	**Main needs expressed**
Training for farmers and professionals	Training for the agricultural sector, training for stakeholders, support for professionals and strengthening of technical skills
Agroecology and sustainable agricultural practices	Training in agroecology, promotion of diverse agricultural practices, soil fertility management, land restoration

Consumer education and awareness-raising	Nutritional education, raising awareness of healthy diets, consumption of local produce, reduction in ultra-processed foods
Training for decision-makers and public policy	Training for decision-makers, improving understanding of public policy, coherence of agricultural and food policies
A systemic and multidisciplinary approach	Cross-cutting training, a holistic approach to food systems, links between agriculture, nutrition, the environment, the economy and governance
Governance and stakeholder participation	Participatory approaches, stakeholder involvement, coordination between stakeholders and the inclusion of citizens in decision-making
Research, data and knowledge transfer	Dissemination of scientific knowledge, diagnostic tools, data on food systems, and the application of research findings
Sectors and value chains	Knowledge of market opportunities, improvement of local supply chains, processing of agricultural products, transparency and better distribution of value
Environment and resource management	Waste and food waste management, reducing the environmental impact of food, natural resource management

Five key priorities emerge from a review of the contributions.

1. Strengthening the skills of all stakeholders:

The most frequently cited need relates to training for farmers, supply chain professionals, public decision-makers and other stakeholders. The responses also highlight the need for competent trainers, suitable training facilities and adequate funding.

2. Moving from a sectoral approach to a systemic approach

Several contributions call for breaking down the silos between agriculture, nutrition, the environment, processing, marketing and public policy. Training should enable participants to understand the interactions between these dimensions and the effects of decisions taken at different levels.

3. Developing technical skills in agroecology and sustainable production

The responses mention training in agroecology, the diversity of agricultural practices, soil fertility and restoration, integrated natural resource management, pests and phytopathological diagnostics. They also address local processing and agricultural innovation.

4. Better linking food, nutrition and the environment

Nutrition education, healthy diets based on local produce, consumer awareness, the environmental impacts of food, and the reduction of food loss and waste are recurring themes in several regions.

5. Linking knowledge to public policy and regional dynamics

Participants call for better integration of research into decision-making, more coherent public policies, strengthened regional governance and greater participation by citizens and relevant stakeholders.

- What projects, initiatives, programmes or networks related to sustainable food systems are you aware of at national, regional or international level?

87 responses were provided, grouped according to the regions indicated by the respondents. This is an inventory and not a ranking by frequency of mention.

Region	Projects, initiatives, programmes and networks cited
Europe	FutureFoodS Partnership; DEPHY; Agralife; Osaé; DIVINFOOD; FAO; Terralim; PAT France; PAFaO; UNESCO Chair in World Food Systems; 'Sustainable Food Systems' Knowledge Community (SyaD); SADUR
North Africa	Food systems transformation project led by the World Bank and MAPMDREF; urban farms; Terre Verte Maroc; MASSIRE
West Africa	GeCROC; UP-RISE; Food-EPI; DUNDI FERLO; FSRP; FERLOSINE FAIRCARBON; Or4food; DYTAES; SAFEVEG; SAFOODS; REPER; Fair Sahel; ProPulse; MAHDIA; MARIGO
Central Africa	Scaling Up Nutrition; FCI4Africa; AFSF; WFP and VLIR-UOS initiatives in the DRC on climate-smart agriculture; CORAF; FAO; GEF; Biofin
East Africa	FSRP; DESIRA; GRET; FAO; AGRA; RUFORUM; ARUA; InnoFoodAfrica; AFRETEC; national initiatives to transform food systems in Madagascar
Southern Africa	CoE-FS; HARNESSFARMS in Malawi; FAMA
Other international initiatives	CSA-FAO; Food Systems Sustainability Transitions Institute (Uruguay); Soil Star; World Microbiome Partnership; AfriFOODlinks; SystemAgrOH

General summary of findings

The responses highlight several cross-cutting priorities:

- Food security, resilience, nutrition and health, and the environment are key objectives of the transition to sustainable food systems.
- Inequalities in access to food and a lack of coordination in public policies are the two most frequently cited problems.
- The relocalisation and structuring of food supply chains are the most frequently cited levers for action.
- Training for farmers, nutrition education and a systems-based approach emerged as key needs in the open-ended responses regarding training requirements.
- The diversity of the projects and networks mentioned demonstrates the existence of initiatives across different regions.

These results highlight the participants' interest in linking public policies, training, research and the development of regional food supply chains to support the transition towards sustainable food systems.

ii) Project presentations

Co-chairs:

Arlène Alpha, CIRAD & Emmanuelle Maguin , INRAE, France

& Catherine Kunyanga, U. of Nairobi, Kenya



The projects, carried out within the framework of TSARA or in collaboration with TSARA, are detailed in Section II (abstracts and slideshows).

The titles, authors, institutions and scopes are as follows.

Parallel session A - Sustainability of food systems, food and nutritional security, health safety - Arlène Alpha & Emmanuelle Maguin

Are healthier diets culturally affordable in Africa? Evidence from four African countries	Joaquin	AMELLER	Cirad	Ethiopia, Kenya, South Africa, and Uganda
Heterogeneity in farmers' preferences and willingness to pay for improved climate-resilient enset varieties in Ethiopia	Tesfaye Etensa	GUTA	AAU	Ethiopia
Temporary Migration and Household Food Consumption in Nigeria	Elodie	MAITRE D'HOTEL	Cirad	Nigeria
A Glance at African foods and their effects in Inflammatory Bowel Diseases	Moez	RHIMI	INRAE	Namibia
Surveys on breastfeeding practices in the south-east of the Democratic Republic of Congo	Francisca	NGENDA KABOMBO	U. Nantes	Congo
Influence of Household Power Relations on Dietary Diversity and Food Access for Pregnant Women, Lactating Mothers, and Under-Five Children in Akaki Kality Sub-city, Addis Ababa	Tadese Elleni	TAMIRE	AAU	Ethiopia
Genetic and phylogeographic characterization of H9N2 avian influenza viruses circulating in Mali and dispersal dynamics across Western Africa	Idrissa Nonmon	SANOGO	U. Ségou	Mali
Valorisation of Morocco's microbial resources for applications in human nutrition and health through sustainable collaboration between the MICALIS INRAE Institute (France) and the CNRST in Rabat (Morocco)	Christel	MAILLET	INRAE	Morocco
Agricultural Transformation and Food Security in Africa: Challenges, Lessons, and Future Prospects	Bekele Wegi	FEYISA	AAU	Ethiopia

Parallel session B - Food processing technologies and/or water-energy-food nexuses - Catherine Kunyanga

Performance drivers in West African cashew processing SMEs: An integrated analysis of technical and organizational factors	MamadouTanou	DIALLO	UGB	Sénégal, Burkina

Impact of peanut varieties on the nutritional quality	DorianeDelacroix	OUEDRAOGO	AgroParisTech	Senegal, Mali, Ghana, Niger, Malawi, Zambia, Togo, Mozambique, Uganda
Diversity of Cameroonian legumes and sustainable processes for the manufacture of infant flours	Adeline	BOIRE	INRAE	Cameroun
Sustainable use of edible insects in Cameroon: nutritional quality, process optimisation and stability of flours from Rhynchophorus phoenicis, Imbrasia truncata and Imbrasia epimethea	AymarRodrigue	FOGANG MBA	Univ Douala	Cameroun
Sociotechnical analysis of the mango sector in Senegal: an overview of the Africold project.	Fatou-Toutie	NDOYE	INRAE	Sénégal Tanzanie
Dynamics and Constraints of Camel Production in Morocco	Fadwa	GUIMIMI	IAV Hassan II	Maroc
SenBICPha - Mapping and qualitative characterisation of fish products preserved by traditional fermentation in Senegal with a view to optimising processes	Marie-France	PILET	INRAE	Sénégal
Assessment of the Phytotoxicity of Dairy Wastewater Using the Lettuce Plant (Lactuca sativa L.) and Duckweed Plant (Lemna minor) as Bioindicators	Oulaya	ZOUI	ENA Meknès	Maroc
International trade and water management in agriculture: the case of Tunisia	Sarra	KEKLI	INRAE	Tunisie

Posters

Valorization of sardine (*Sardina pilchardus*) fillet scraps and by-products generated during canning processing for the production of nutritional flour and oil intended to enrich foods	Hind	MKADEM	IAV Hassan II	Maroc
The international meetings 'Milk as a Vector for Development': origins and objectives	Said	BOUHALLAB	INRAE	Continent
Using genomic information to characterise the adaptation and vulnerability of local European and sub-Saharan African cattle breeds to climate change.	Dominique	AHOUANHODE	INRAE	Côte d'Ivoire
Assesment of Coffee Housses Business in Addis Ababa: Post COVID-19 Marketing Trend	Molla	Setargew MEKASHAW	AAU	Ethiopie
Emergence of cowpea bacterial blight in Burkina Faso - NIEBABU	Nanwinyele Euvaris	SOME	INERA	Burkina Faso

iii) Summary of presentations and outlook

Parallel session A - Sustainability of food systems, food and nutritional security, health safety - Arlène Alpha & Emmanuelle Maguin



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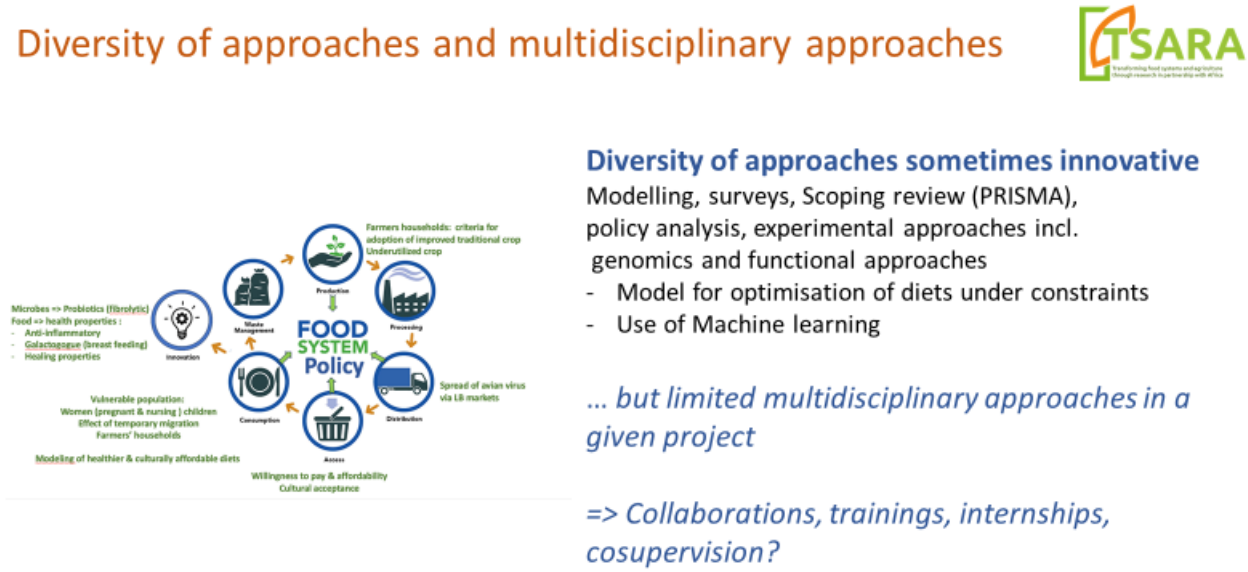


Multidimensional approaches:

Integration of the multiple dimensions of food and the trade-offs between these dimensions

- Cultural acceptability versus economic accessibility/affordability
- Short-term benefits versus long-term benefits

- ex, farmers criteria for adoption of improved crop

- Balance between positive and negative aspects
  - ex, increased consumption of fruit, vegetables and milk in households with a member who has returned from emigration versus increased consumption of fats, sugars and processed product

Factors that can be questioned depending on local & cultural contexts

- ex, Ethiopia reported that dietary diversity is lower when women dominate decision about meal preparation. Improvement with more parity in food-related decisions.

Recommendations for food-policy

Consider the decisive nature of certain factors that can vary depending on the context, sub-population typologies (farmers typologies, vulnerable pop) and geography

- Importance of economic constraints on the behavior of actors in food systems (producers, consumers)
- Eating habits and approach to diet in relation to cultural acceptability, changes brought about by migration dynamics, understanding of how the gut microbiota works, diversification during breastfeeding, traditional recipes and the Mediterranean diet
- Support women empowerment not only at household level but also at community, national levels

Take home messages:

A very rich and interesting session with excellent quality work:

=> Often publications, oral presentations, new projects

=> Majority of projects/collaborations developed training, mobility of young researchers and PhD's co-supervision

PROSPECTS

- Strengthening multidisciplinary approaches in projects (through TTF meetings?)
- Better integrate environmental challenges and issues
- Highlighted the importance & need for exchange of knowledge and of people mobility => to dev.?
- TTF Food system transformations and nutrition for Health

Promote food systems based on agrobiodiversity to:

- ➢ combat the various types of malnutrition (undernutrition, micronutrient deficiencies, overweight/obesity)
- ➢ help preserve the richness of African microbiota and the host-microbiota symbiosis.

- ✓ Both priorities addressed by the projects
- ✓ Updating axis and strategy with new partners will be an asset

Parallel session B - Food processing technologies and/or water-energy-food nexuses - Catherine Kunyanga

The session featured eight insightful PowerPoint presentations delivered by various researchers, primarily PhD students specializing in agri-food processing. The first sequence comprised four presentations: two lasting 10 minutes each and two lasting 5 minutes, followed by a 10-minute Q&A session. The second sequence also included four presentations: one for 10 minutes and three for 5 minutes, concluding with another 10-minute Q&A.

Agri-food processing plays a crucial role in achieving food and nutrition security across many nations. The findings presented focused on enhancing the processing of cashew nuts, peanuts, legumes, and fish value chains, including innovative approaches to edible insects and camel production by pastoralists in Africa's dryland regions. The research outlined technologies, innovations, practices, products, processes, strategies, and policies that significantly contribute to improving food and nutritional security in various countries.

Presenters showcased trans-disciplinary and multi-disciplinary studies, covering topics such as molecular breeding techniques for improved traits, enhancements in food nutritional quality, process optimization for products like fermentation, dehydration, and freezing, as well as product development for specialized demographics, including infant foods. Additionally, they addressed postharvest technology management, particularly cold chain logistics, and the commercialization of camel products like pasteurized and fermented camel milk and camel cheese in arid regions. The presentations also explored the valorization and market development of plant food products, water management, trade, and the interconnections between food, water, and energy.

The timing of these findings is particularly relevant, as food systems are currently undergoing rapid transformations that significantly impact diets. Influencing factors include globalization, expanding food trade, technological innovations, extended food supply and processing chains, and the volatile prices of food commodities, all exacerbated by the global recession following the Covid-19 pandemic.

For TSARA:

- Increase more visibility to attract multi-sectoral and multi-disciplinary social economic actors in the South.
- Enhance knowledge exchange and sharing through student and staff mobility's between South and North as well as South to South.
- More partnerships and collaborations across board.
- More interactive forums like TSARA science days.

2.3. SESSION 3: INTERACTIONS AGROECOLOGY - SUSTAINABLE FOOD SYSTEMS

Chair:

Awa Diattara, Gaston Berger University, Senegal



Session 3 focused on drivers of change and dynamics of action, confirming agroecology as a key tool for strengthening regional autonomy, relocalising supply chains and promoting more coherent food policies. It also highlighted the importance of existing networks, projects and partnerships, as well as the need to strengthen training, multi-stakeholder governance and the science-policy dialogue.

i) Participatory mapping of the 'landscape'

Facilitator:

Khadija Jaafary &

Wiam Moumen, IAV, Morocco





Of the 91 survey respondents, 55% were men and 45% were women, with a median age of between 40 and 54. The questions and answers provided are as follows.

- **To what extent is agroecology essential to the sustainability of food systems?** On a scale of 1 to 5, 49% consider it very important, and 41% consider it absolutely essential. The other responses (optional, not very important, moderately important) did not receive much support, partly because it is sustainable agriculture (beyond agroecology) that is important. There are numerous reasons given for rating it as 'very important' or 'absolutely essential' (the questions allowed for comments): for the survival of humanity, we must remain within planetary boundaries, and only agroecology ensures the various dimensions of sustainability, resilience and equity, as well as food sovereignty. A focus on conserving resources (which are finite), soil quality and the stability of ecosystems preserves the environment for future generations, improves product quality and ultimately enables sustainable production.
- On a scale of 1 to 5, **to what extent can agroecology feed the world's population** (in terms of both quantity and quality)? The response '4: to a large extent' was the most common (54% of voters), but the view '3: to a moderate extent' (24%) was significant, outnumbering those who believe that agroecology can fully feed the planet (18%). Negative views accounted for 7% of voters.
- **In what ways is agroecology a driver of transformation in food systems?** The most popular responses are 'improving food quality and diversity' (64% of voters) and 'reducing environmental impacts' (53%). These were followed by 'improving the autonomy of producers and local areas' (38%), 'challenging the organisation of supply chains and policies' (28%) and 'promoting short supply chains' (21%).
- In your context, **what is the most urgent lever to activate in order to transform the food system?** The most popular response is 'reorienting public policies and agricultural subsidies' (67% of voters),

followed by 'relocalising and structuring food supply chains (food sovereignty, territorialisation)' (46%). Next, tied for second place, were 'changing dietary habits' and 'strengthening regulation of private actors and limiting the influence of lobbies' (34%). Tackling food loss and waste came last (26%).

- In your opinion, **are your country's agricultural and food policies consistent with the principles of agroecology?** Unsurprisingly, the response 'somewhat consistent' was the most popular (34% of voters), ahead of 'not at all consistent' (21%) and 'fairly consistent' (16%). No one believes that agricultural and food policies are consistent with agroecology!

- **Which priority areas or levers are key to linking agroecology with sustainable food systems?** 74% of respondents favoured the answer 'short supply chains/local food initiatives/local produce', considering these to be the most dynamic levers at present, as they promote products and ensure fair remuneration for local producers. Next comes organic farming (31%), which is both agroecological and already organised as a sector. This is followed by reducing food loss and waste (17%) and more plant-based diets (11%). An 'other' category was also provided. Several ideas were put forward: better aligning consumer expectations with farmers' practices; limiting the influence of lobbies on political decisions; and repositioning agroecology within the framework of sustainable agriculture adapted to climate change.

- One question concerned **projects, programmes and networks relating to the link between agroecology and food systems**. As before, the list of networks and projects mentioned is not included here: there are a great many of them, some international in scope and others local, across the various regions of the African and European continents. The TSARA secretariat has made available to readers a comprehensive list of acronyms, the details of which (objectives, funding, partnerships, operational procedures, regions involved, deliverables) are not analysed here.

ii) Project presentations

Co-chairs:

Zoubir Chattou, ENA Meknes, Morocco

& Tobi Akinropo, Obafemi Awolowo University/INRAE, Nigeria/France





The projects, carried out within the framework of TSARA or in connection with TSARA, are detailed in Section II (abstracts and slide presentations).

The titles, authors, institutions and scopes are as follows.

Parallel session A: Territory (local, political, etc.) – Zoubir Chattou

Dynamics, Drivers, and Impacts of Land Use and Land Cover Changes in the East African Highlands: A Systematic Review and Meta-Analysis with Evidence from Ethiopia	Getachew Woldemedhin	DAGNE	Salale University, College of Agriculture and Natural Resource, Fitche	Ethiopie
Agroecological heritage and territorial transition: lessons from the PRATAM dynamic in Lower Casamance	Raphael	BELMIN	CIRAD	Sénégal

Conditions for job creation in rice-growing areas engaged in agroecological transition in Senegal: the case of the Senegal River Valley	Pape Bilal	DIAKHATE	ISRA	Sénégal
Understanding Agricultural labour in Burkina Faso: Looking at Gender Constraints and Satisfaction in Conventional and Ecological Rice Fields	Eveline	COMPAORÉ SAWADOGO	INERA	Burkina Faso
The ASAP (Agroecology and Agro-Sylvo-Pastoral Systems) dP focuses on designing agroecological innovations and production systems that meet the expectations of food system operators and consumers in Benin, Burkina Faso, Côte d'Ivoire and Mali.	Eric	VALL	CIRAD	Bénin, Côte d'Ivoire, Burkina, Mali
Sustainability of agro-silvopastoral practices in Ifrane National Park (Middle Atlas, Morocco) in a context of climate change.	Noé	DANIEL NGUYEN	Institut Agro Rennes-Angers	Maroc
Agroecological Innovation Pathways for Food System Transitions in Remote Agro-Pastoral Regions of Kunene, Namibia	Léon	BICKEL-PASCHE	Institut Agro Montpellier	Namibie
Pastoralism, resilience and food security: a viability-based model applied to Senegal	Daouda	NDIAYE	CIRAD	Sénégal
Local markets for agroecological products in Morocco: the challenge of product supply, the absence of an institutional framework and consumer perceptions: the case of Souk Al Fellah and the Bio Shoul cooperative market in Rabat	Mohamed	EL AMRANi	ENA Meknès	Maroc

Parallel session B: Approach (modelling, monitoring, resilience) – Tobi Akinropo

Sustainable Food Systems in Ethiopia: Bridging Agro-ecology, Resilience, and Food Security	Bekele	AKLILU	AAU	Ethiopie
Spatial modelling to advance sustainable rangeland management in Africa	Gianni	BELLOCCHI	INRAE	Afrique du Sud, Sénégal, Maroc
CAMPIGEN: genetic diversity of indigenous pigs in Cameroon and agroecological resilience	Pierre	FAUX	INRAE	Cameroun
Bridging agroecology and food systems: Scaling potential of multistakeholder fodder innovation in the Senegal River Delta	Serena	FERRARI	Cirad	Sénégal
Phage biocontrol for the emerging bacterial leaf blight epidemic in Madagascar	Clara	TORRESBARCELO	INRAE	Madagascar
Can local radio stations contribute to epidemiological surveillance?	Sarah	VALENTIN	Cirad	Cameroun
MORFeuS: Nexus Water-Energy-Food-Ecosystems solutions for resilient Mediterranean territories	Laure	HOSSARD	INRAE	Algérie, Maroc, Tunisie
Electrochemical inactivation of free-swimming parasites; Free chlorine and electric field as potent disinfection agents for Schistosoma mansoni cercariae	Begumisa	GODFREY MAGYEZI	Mbambara University	Ouganda
Resilience and functional stability in a sub-humid South African grassland under a decade of climatic and management variability	Lily	MUNZHEDZI	Univ. South Africa	Afrique du Sud, Sénégal, Maroc

Posters

The AWA Project (Agroecology in West Africa) - Agroecological food systems for sustainable agriculture and healthy food in West Africa	Eric	VALL	Cirad	Sénégal, Bénin
Climate Change–Food System Interactions and Smallholder Farmers' Adaptation Strategies: Evidence from the Omo River Headwaters, South-Central Ethiopia	Elias	SHIFERAW	AAU	Ethiopie
Organisation of value chains and agroecological transition of food systems: an exploratory case study in Senegal	Fatimatou Zahra	NDOYE	Institut Agro Montpellier	Sénégal
Anaerobic Digestion-Mediated Bioactivation of Biochar: Physicochemical transformation and nutrient content alteration for Soil Amendment	Eniyew	ABEBAW	AAU	Ethiopie
Evaluation of the diversity of Ralstonia solanacearum species complex in Ghana and selection of tomato rootstocks resistant to bacterial wilt disease.	Matilda	FRIMPONG	INRAE - CSIR	Ghana

iii) Summary of presentations and outlook

Parallel session A: Territory (local, political, etc.) – Zoubir Chattou

Key message:
Agroecology is a key driver for rural development, promoting sustainable and resilient food systems through local knowledge, resources and collective action.
6 priority areas:
- land use and transition: agroecological strategies co-designed and adapted to the local context;
- heritage and knowledge: promoting local practices and participatory innovation;
- employment and inclusion: the creation of fair and decent rural jobs;
- innovations: technical, social and organisational solutions to build resilience;
- livestock farming and food security: strengthening resilient pastoral systems;
- markets and consumption: linking production, the local area and local markets.

Objective: to integrate agroecology, social inclusion and sustainable food systems through action-oriented research and support for public policy.

Parallel session B: Approach (modelling, monitoring, resilience) – Tobi Akinropo

The session focused on the interactions between agroecological transition and sustainable food systems. Several complementary approaches were addressed, including modelling, monitoring and resilience across different production systems. The session featured a diverse and interdisciplinary set of projects and presentations, with a broad geographical coverage. Collectively, the projects highlighted how the agroecological principles are mobilized in achieving sustainable food systems, particularly in guiding production operations, consumptions and environmental sensitivity of the food system.

In total, nine presentations (three presentations of 10 minutes and six presentations of five minutes each) were made. The presentations recognize the transdisciplinary nature of an agroecological approach which embraces science, a set of practices and a social movement.

As as scientific approach, the integration of research, education, action and change that brings sustainability to all parts of the food system: ecological, economic and social movements. Four presentations employed the research-based approaches. The project titled Phage biocontrol for emerging bacterial leaf blight epidemic in Madagascar explored the use phages as biocontrol agents as alternative to increased use in pesticides, Modelling approaches were applied to support informed decision-making in farm practices and fodder managements towards advancing sustainable rangeland management in Africa. Genetic tools and molecular techniques were employed in the project Genetic diversity of indigenous pigs in Cameroon and agroecological resilience, which aimed to assess admixture levels in indigenous breeds and explore their potential to support resilient swine production systems, thereby contributing to biodiversity conservation. Finally, an ongoing grassland study in the sub-humid pedo-climatic region of South Africa focused on achieving resilient and functionally stable grasslands to support livelihoods and guide sustainable land management.

As a set of agricultural practices, three projects seek ways to improve agricultural systems by harnessing natural processes, creating beneficial biological interactions and synergies amongst the components of agroecosystems, minimizing synthetic and toxic external inputs and using ecological processes and ecosystem services for the development and implementation of agricultural practices consequently enhancing sustainable food system. For the Social movements, project identified the use of radio-based data collection, emphasizing the inclusion of local communities to improve epidemiological surveillance. Also, A project focused on the scaling potential of multi-stakeholder's fodder innovation in the Senegal River delta identifying strong links with social relationships, value, belief and deep scaling approaches.

In conclusion, the interactions between agroecological transition and sustainable food systems are significant as they contribute to improved resource-use efficiency, strengthened food system resilience, enhancing equity and responsibility in policies and governance across the entire food system.

2.4. SESSION 4: DISCUSSION AND OUTLOOK

Chair:
Norman Maïwashe, ARC, South Africa



Following on from the presentations of projects carried out in the fields of agroecology and/or sustainable food systems, either within the framework of or in connection with TSARA, and from the various summaries of these presentations and the dedicated sessions, Session 4 aimed to **identify guidelines and avenues for research, actions and projects to be undertaken, as well as practical approaches to ensure that TSARA has an impact.**

Following a summary of the sessions by the chairs and co-chairs (see § 2.1.iii), 2.2.iii), 2.3.iii)) followed by a participatory summary, **two round-table discussions were held to gather recommendations** from participants with different and complementary backgrounds (agricultural producers, science-policy interface, the private sector and NGOs, and research).

i) Participatory summary and overview

Facilitator:
Wiam Moumen, IAV, Morocco
& Zeine Zein Taleb, ENAM, Morocco





The aim of this session is to gather feedback from participants on the three previous sessions in order to **inform future Science Days**. The following results are supplemented by elements from **the DEBRIEFING** and feedback from **the POST-SCIENCE DAYS QUESTIONNAIRE**, at the end of this document.

During the session, 93 participants completed the survey. 25% of them were aged under 40, 25% over 55, nearly half were aged between 40 and 55, with an almost equal proportion of women and men, though there were slightly more women than men.

Evaluation of the first three sessions: % of **positive feedback** (rating of 4 or 5 out of 5) – on the following aspects:
- Practical insights into **agroecology**: 66%
- Contributions to **sustainable food systems**: 51%
- Understanding of the interactions between the two: 40%
- **Clarity and scientific quality of the presentations**: 58%
- **The smooth flow and dynamism** of the presentations and discussions: 58%
- **Organisation** of the sessions and the flow between the different segments: 58%
- **Technical aspects**: 55%.

The three key words selected from the three sessions (a mix of English and French):



The major current challenges relating to agroecology that were effectively addressed during these sessions (maximum of 3 words; a mix of English and French):



Ways to enhance the impact of research (maximum of 3 words; a mix of English and French):



Wishes for future Science Days, in terms of themes, format and audience (maximum of 3 words; a mix of English and French):

- Themes / Topics: adaptation to **climate change**, **digital** agriculture, agricultural **employment**, **biodiversity** conservation, **water management/ReUSE**, ***One Health* for food security**, evaluation of **public policies** (particularly regarding agroecology) and the involvement of public authorities and policy-makers.
- Format / Organisation: **in-person** events (and/or hybrid), over a **longer period** (3 days), to allow for greater **interaction** and **in-depth discussion**; oral presentations of posters, feedback and **sharing of experiences** (successes and failures), **project** workshops, and **awards** for the best presentations and posters.
- Audience / Participants: **a multi-stakeholder group**: researchers from both the public and private sectors; a large number of students; practitioners in the field – farmers, project beneficiaries, local organisations –; public decision-makers – politicians, government departments –; donors and potential funders.

ii) Round table 1: views and recommendations from leading figures with complementary backgrounds to ensure TSARA makes an impact

Moderator:

Mady Cissé, Professor of Food Technology and Head of Training at Cheikh-Anta-Diop University (UCAD), Senegal



Panellists:

Saïd Chatibi, Director of the National Sheep and Goat Association, Morocco



Debele Debela, coordinator of Cluster 4: Accelerated Mechanisation, Enhanced Digital Technology and Innovation for the Transformation of Food and Nutrition Systems in Ethiopia (EFSTN), at the Ethiopian Agricultural Transformation Institute (ATI), Ethiopia



Khadi Desprez, Head of the Africa Division at the Avril Foundation, France



Sophie Nicklaus, Scientific Director for Food and Health at INRAE, France



Key points:

To contribute, through research and training, to ensuring access to healthy food for all, creating value and jobs, and preserving resources:

- collaboratively develop **pathways** at a **regional** level in an **inclusive** manner,
- take a holistic view of **food systems and value chains**, linking the agricultural upstream sector with the downstream consumer sector, promoting products, and bringing together producer and consumer regions,
- support **policy coherence** and the implementation of **innovative public schemes**,
- developing **technologies and digital data** to support adaptation to climate change and risk forecasting, productivity, job creation, the inclusion of young people and women, dietary diversity and nutritional value, and decision-making support,
- focus in particular on **plant-based proteins, local breeds** and the preservation of pastoral land,
- establish mechanisms for **monitoring** actions, accountability and **risk-sharing**,
- identify underlying **research questions** and the **science-policy interfaces** to be developed.

TSARA: collaborative research carried out across various thematic areas with the shared aim of helping to transform food systems and agriculture to ensure access for all to healthy, sustainable and equitable

food, as well as food and nutritional security, whilst conserving resources and creating value and jobs. The aim is to co-create and share new knowledge, analytical frameworks, methods and transformative innovations.

WHAT PRINCIPLES, LEVERAGES AND TOOLS SHOULD BE HARNESSED TO ACHIEVE THIS COMMON OBJECTIVE AND RECONCILE SOMETIMES CONFLICTING ISSUES, AGAINST THE BACKDROP OF EXACERBATED AND ESCALATING CLIMATE CHANGE, WHICH IS AFFECTING CROPS, LIVESTOCK AND RESOURCES?

PRINCIPLES HIGHLIGHTED:

- the function of food systems must be to feed populations, an essential condition for achieving the Sustainable Development Goals, in particular SDG 1 No Poverty and SDG 2 Zero Hunger, which are the pillars upon which the others can be built;

- linking the agroecological transition with the food transition is not necessarily straightforward: for example, projects focusing on agroecology do not always address the issues of agri-food processing and market access; Livestock farming must both meet a growing demand for animal protein and protect the environment, particularly as grazing land becomes increasingly degraded due to climate change and livestock density; nutrition must be viewed within this context as a priority issue;

- environmental conservation is essential to maintaining the long-term productivity of food systems; the depletion or degradation of resources is a reality across all regions of the world;

- agriculture must help to support economic development and ensure fair remuneration for producers, whilst offering affordable products to consumers and striving for a fair distribution of value throughout the food chain;

- discussions on the organisation of food systems must take into account the entire value chain: food processing has a dual benefit, saving time for end-users and generating economic value; the organisation of outlets for agricultural produce is therefore also key to ensuring this economic development;

- there is no trade-off to be found between innovation, mechanisation and employment, but rather between today's low-productivity jobs and the high-quality, resilient jobs of tomorrow; Innovation must open up new employment opportunities across the entire food system, transforming work rather than replacing it, with fewer manual jobs in the field and more skilled, resilient and better-paid roles; productivity gains are a prerequisite for sustainable employment - without productivity growth, job creation in agriculture risks contributing to poverty rather than reducing it;

LEVERAGES AND AREAS ADDRESSED/TO BE ADDRESSED:

- understanding food systems in their entirety, with i) job creation throughout value chains, in line with the Malabo Value Chain Development Programme as well as SDG 9 Industry, Innovation and Infrastructure and SDG 12 Sustainable Consumption and Production; beyond production: processing, nutritional optimisation, value addition to food products, storage and logistics; ii) the development of functional value chains and markets that link producers to consumers and enable the latter to access affordable and nutritious food;

- associated policy coherence – aligning agricultural, health, trade, environmental, industrial and social protection policies with a shared vision of food systems – strong political leadership and innovative mechanisms; for example, in Ethiopia, 16 ministries and development partners are mobilised to transform food systems as a whole, brought together in an inter-ministerial steering committee

chaired by the Deputy Prime Minister; the government is implementing initiatives to facilitate market access and the processing by women's cooperatives of foods traditionally consumed in Ethiopia, such as teff flatbreads or injera; this public policy on market creation has succeeded in linking the agricultural upstream sector with the downstream consumption sector and in connecting regions – with significant flows between rural areas and increasingly densely populated urban consumer centres;

- the development of human capital and the empowerment of young people and women (skills, entrepreneurship and leadership);

- the roll-out of productivity-enhancing and climate-adapted technologies (mechanisation, improved seeds, water-efficient irrigation methods and infrastructure, soil management technologies);

- agricultural innovation, climate-smart technologies, digital tools, precision farming and mechanisation deliberately designed to create new rural jobs by shifting from low-productivity manual labour to services such as mechanisation, equipment supply, assembly and the manufacture of spare parts; to promote the inclusion of young people and women, increase yields and incomes, improve the availability and affordability of food, and enhance dietary diversity and nutritional value;

- the use of digital data for advisory services and decision support (characterisation of changes, early warning and climate risk management, demand and forecasts for inputs, market information);

- promotion of nutrition-sensitive agriculture and the creation of a suitable food environment: incentives for nutrient-rich crops and livestock, food fortification and the creation of added value; communication and consumer awareness-raising to encourage healthy eating habits;

- financial incentives and risk-sharing mechanisms;

- monitoring, accountability and learning systems;

- in the area of crops: developing plant-based proteins;

- in relation to livestock farming and pastoralism: working with local breeds of sheep, cattle and goats that have proven resilience to climate change; developing forage resources: protecting pastoral lands from land grabbing through appropriate public policies, and enhancing the value of agroforestry areas; promote collective management practices for grazing lands and technical expertise in livestock systems to enhance the efficiency of production systems and minimise losses and waste in the use of resources; understand and support the current transformation of the livestock system and the new practices being developed in response to climate change and recurring droughts; add value to products through processing and facilitate market access by ensuring fair remuneration that is equitably distributed across the value chain.

IMPLEMENTATION METHODS:

- an inclusive, co-constructive approach at the local level, working with local communities;

- first and foremost, to define the pathway to be adopted in a given region to achieve a sustainable, inclusive and resilient food system; pathways agreed locally will not be identical but will combine the aforementioned levers in different ways to identify solutions tailored to regional challenges in the short, medium and long term;

- ensuring projects are long-term whilst setting clear timeframes (successive phases that are launched and completed), with concrete and quantifiable actions;

- the TSARA community's structuring of a scientific agenda based on research questions that arise in order to respond as effectively as possible to the challenges and issues at hand, by identifying those that require complementary expertise, thereby demonstrating how, beyond the diversity of the topics addressed, the community is taking the initiative;

- the inclusion of a science-policy interface component within this scientific agenda: how can TSARA contribute to shaping the trajectories of countries grappling with the specific challenges identified locally? How can the interface between science and public policy be developed?

iii) Round table 2: views and recommendations from members of TSARA's External Advisory Committee (EAC) to ensure TSARA makes an impact

Moderator:

Prisca Mugabe, Associate Professor, Department of Animal Sciences, Faculty of Agriculture, Environment and Food Systems, University of Zimbabwe



Panellists:

Laurent Bochereau, Minister-Counsellor for Science, Technology and Innovation at the Delegation of the European Union to the African Union, Ethiopia



Jannis Dimitriou, Chair of Agrinatura and Associate Professor at the Swedish University of Agricultural Sciences (SLU), Sweden



Janet Maro, Co-founder and Chief Executive of Sustainable Agriculture Tanzania (SAT), Tanzania



Patrick Okori, Executive Secretary of the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), Uganda



Key points:

TSARA is a **research community** capable of providing scientific evidence and contributing to the development of human capital for the future.

To maximise its impact, TSARA must be a **hub of knowledge and expertise**:

- developing **participatory and locally-rooted research** based on multi-stakeholder platforms/living labs where practitioners and scientists interact, and where young people and women are particularly involved,

- developing a focus on **training** and support for students,

- **working in partnership and synergy** with other comparable platforms, institutions or initiatives,

- focusing in particular on the study and promotion of **local plant and animal resources**, and on **markets and value chains**,

- focusing on **synthesising these results and communicating them**, by highlighting success stories and formulating a narrative,

- connected to the **science-policy interface** at various levels, and in particular to the African Union-European Union (AU-EU) dialogue,

- to **convince decision-makers and the private sector** of the importance of supporting research and securing **funding**, for example from the EU or from foundations.

WHY IS CHANGE SO DIFFICULT, WHEN THE CHALLENGE LIES IN TRANSITION AND TRANSFORMATION?

We are dealing with a complex issue that involves different fields and different stakeholders. TSARA provides scientific evidence and, through PhD programmes, is developing new human capital for the future. TSARA can be proud of what has been achieved, including participation in the four webinars: this has already had an impact, primarily within the scientific community. But what about the other communities involved in the transition?

It is important to highlight the lack of interaction between science and policy in these debates. Where are the representatives from ministries or government agencies? TSARA must be able to act as a hub for knowledge and expertise, connected to the science-policy interface. The AU and the EU have developed a joint initiative on FNSSA (Food, Nutrition, Security and Sustainable Agriculture), launched in 2016 with over 300 projects funded by Horizon 2020 and Horizon Europe across three areas: sustainable intensification, food systems for nutrition, and market and trade expansion. The roadmap is currently being updated by a panel of six experts – three Africans and three Europeans – and there will be an opportunity to submit comments. Please do so.

We also need results that are presented at the appropriate scale: on the one hand, at the level of the continent and regional research organisations such as FARA; on the other, at the level of multilateral funding agencies – the EU being one such body, though many others exist. Finally, we must draw on multi-stakeholder platforms where scientists and practitioners interact, such as living labs.

There is a key challenge in disseminating the findings at other conferences and forums to reach a wider audience, but also in ensuring that these findings are taken on board, so that they are implemented on the ground, with a particular focus on young people and women, who must not be left behind. Networking with other platforms, institutions or initiatives working on agroecology or the transformation of food systems is necessary to create synergies, avoid duplication, and also to have a greater impact.

WHAT TOOLS, WHAT FUNDING, WHAT RESOURCES?

What we have with TSARA and these Science Days is a research community. But we must also consider how to summarise these findings and communicate them. For example, what do we say in summary of the research on the transformation of food systems? These are two very important points, essential for securing funding.

To access funding such as that provided by the Gates Foundation, Mastercard and many others, we need to have a story to tell, and this is where the science-policy interface becomes crucial. The Horizon Europe programme also supports the development of knowledge and advisory systems (AKIS) for the FNSSA; TSARA could benefit from this. Finally, the IRC for FNSSA - the International Research Consortium, coordinated by FARA - is also an immediate resource. The FNSSA platform is currently focusing on plant health and the sustainability (environmental impact) of food processing. These are issues that have been addressed. But there are also more bottom-up European opportunities: Marie

Curie fellowships, staff exchanges, Africa-Europe mobility schemes… For all of this, we need to work together.

There is a challenge regarding financial resources, and there is also a challenge concerning skills and technical know-how. What can we build using these 'intangible' resources, and how can we 'Africanise' them so that they are useful in the African context? We must work to build these local skills and to support students.

Among these resources are also local plant and animal species, some of which are at risk of extinction because science has introduced exotic crops and foods, whilst we, as researchers, have done little to explore our local resources.

WHAT THEMES SHOULD THE NEXT SCIENCE DAYS FOCUS ON? WHAT SHOULD BE THE FOCUS?

Translational research, rooted in communities and participatory in nature through living labs or other equivalent initiatives, is an avenue worth exploring – a step that goes beyond multi-, inter- and transdisciplinarity. This involves research with local young people and women, who are actively engaged in designing solutions alongside researchers from both the biological and social sciences.

Specific topics, such as markets and value chains – which are rarely discussed at these Science Days - are essential.

Success stories need to be developed to convince political leaders to invest more in research, to create value and to help find solutions to pressing issues for Africa.

iv) Summary of the session – Norman Maïvashe

Just as a recap of where we come from, we started a marathon of these sessions earlier during the month, starting with session one, two, and three, that allowed us to go into depth about three thematic areas, which are agroecological transitions, sustainability of food systems, interactions between these two important thematic areas. And this morning, we were very clear as we got off the ground that the objective of today's session was to consider all the information that has been gathered through the three sessions, synthesize the outcomes with a view to identify direction, avenues for research, actions, and maybe projects to enhance the impact of TSARA. And you will agree with me that indeed, that is what we have done today.

Just as a summary, we did listen or we watched the videos that showcase the good work that is being done by TSARA. We also listened to a very good feedback from the summary of the three sessions. I'm not going to go into details about them. Suffice it to say that the agroecological transitions are put to the fore or it emphasized the need for us to rethink or to have a real look at the 13 principles for agroecology to make sure that these principles are enriched and they are more inclusive. And there was a clear disjuncture that was picked up by the session that what is happening on the ground in terms of the principles that are receiving attention is not comprehensive to cover all the 13 principles. Also there was a need that was highlighted around how we should be looking at agroecology, which was around looking at it as a driver for rural development. And in terms of sustainable food systems, there was an acknowledgement of the diversity of the food systems and also the need to look at the entire toolbox in terms of the approaches that we're going to use to drive the transition and change. And it was emphasized that there is a need to integrate agroecology, social inclusion, and sustainable food systems.

The interactive session was also very rich. We were able to once again identify the priorities such as diversity, resilience and funding. And the participants did rate all the sessions. And one of the things that they suggested was that we should look at a hybrid session, which I think is a good idea.

In terms of the roundtables, I think the discussions were very rich. We did identify the challenges as alluded to by the different panelists. Some of the few things that they highlighted was around the need of looking at the funding constraints, especially in terms of the development work that is done in the public sector or by those organizations that have prioritized development and the need for balancing the long-term strategic priorities with project management realities was also emphasized. And in terms of the levers, technology and specifically digital technology was identified as an area that we should prioritize, as well as the needs for adoption of climate agriculture. The picture around livestock was painted in such a way that there is an increasing demand that the food system needs to respond to the challenge around the singling out of livestock as a major driver of climate change is one thing that also needs to be addressed. And the management of pastoral systems was indicated as an area that we need to look at. Some of the take home messages from the first round table was around sustainable farming being the way to go, looking at plant-based agriculture but also looking at livestock. The opportunity presented by GMOs was also looked at, but also balancing it with nature-based solutions and also the need to harness the interface between science and policy.

And the second round table addressed important questions for the platform. There was an acknowledgement that the TSARA platform is playing an important role but there is a room for improvement. Some of the challenges that faced TSARA were highlighted and some solutions we propose, such as around enhancing science and policy interface, which is currently weak, and also making sure that the outputs are not left to just this smaller community, but it should be broadened so that it's accessible to a broader community, a community that is out there that could benefit. The targeting of specific multinational partners and especially also looking at the African governments was indicated as an important area. And it was indicated that for us to attract funding, we need to be able to focus on success stories. And the other area was around opportunities that are there around sustainable intensification. The work that is being put on the table through European Union initiative is something that we should consider. One other area which is a low hanging food was around the knowledge hub that we are creating through the platform and that there is a need to make it more accessible and so that we are effective. And around resources, the need to synthesize the research results for effective communication was highlighted. And it was also indicated that there is no need to reinvent the wheel, but let's make sure that we adapt whatever technology exists to local conditions. And active engagement of other stakeholders going beyond the community was highlighted as an area that we should look at.

In terms of the issues that we need to look at as we present other engagement opportunities was around the fact that what we're dealing with is transition and therefore there is a need to look at other approaches such as transdisciplinary research, multidisciplinary and so on. And from my side as the chair of the session, I think we really should be proud of ourselves that we were able to engage in this manner.

It's very clear that TSARA is a valuable platform, but perhaps there is a need for us to re-look at how the journey that we have travelled, the processes that we have put in place, some of them may not be as fit for purpose as others. Maybe we just need to review our toolbox so that we continue to enhance the value of SARA. And I need to thank all of you who participated in this session and made it very rich. From my side, thank you very much for being such a great audience.

CLOSING

Fouad Rachidi, Deputy Director for Research and Cooperation, ENA Meknès, Morocco, representing the Director-General and Co-Chair of TSARA



Ladies and gentlemen,

Dear colleagues, dear participants,

It is with a deep sense of satisfaction and hope that I take the floor today to bring to a close this first edition of 'Science Days', organised as part of the TSARA initiative.

The three key themes at the heart of our discussions — agroecology, the food system, and, above all, their dynamic interaction — lie at the centre of the contemporary challenges facing our societies: food security, resilience to climate change, social justice, food sovereignty and the sustainability of ecosystems. Through high-quality scientific presentations, content-rich poster sessions, stimulating discussions and ambitious visions, we were able to appreciate the extent to which research, teaching and innovation must be mobilised together, in a transdisciplinary, inclusive manner rooted in local realities.

These four online sessions were much more than a simple exchange of knowledge: they provided a genuine forum for scientific dialogue, critical reflection and collaborative development, centred on the fundamental issues shaping our agricultural and food future.

I would like to express my most sincere thanks to all those who made this event possible. A special thank you goes to the organising team, whose commitment, rigour and creativity enabled these scientific sessions to be designed and carried out to the highest standard. I am thinking in particular of the members of the Secretariat, the Science Days Steering Committee, and all those who worked behind the scenes to bring this project to fruition with passion and determination.

I would also like to thank all the session chairs and co-chairs, the speakers, the moderators, the presenters, and the technical team, whose discreet yet essential work ensured that every session ran smoothly.

I would like to take this opportunity to extend a warm welcome to all the participants. Your participation has exceeded our expectations: 680 registered attendees from 67 countries — across Africa, Europe, Latin America, North America and Asia — representing 316 institutions. Of these, 68 per cent come from research or educational organisations, whilst ministries, NGOs, international organisations, the private sector and farmers' organisations are also well represented. The linguistic breakdown — 60 per cent French-speaking and 40 per cent English-speaking — reflects TSARA's bilingual and inclusive ethos. Depending on the session, we had between 150 and 250 participants logged in simultaneously, which demonstrates a consistent commitment and remarkable intellectual curiosity.

This geographical and disciplinary diversity has greatly enriched our discussions, thanks to your expertise, your open-mindedness, your patience in the face of inevitable technical glitches, and above all your shared determination to advance the cause of a fairer, more sustainable and more resilient agriculture and food system.

Finally, allow me to pay tribute once again to our long-standing partner, Cirad, co-chair of TSARA, and in particular to Mr Jean-Paul Laclau, Deputy Director-General in charge of Research and Strategy, for his inspiring opening address, which laid the perfect foundations for our discussions.

The TSARA initiative embodies precisely what international scientific collaboration should be: rooted locally, thinking globally, and always focused on concrete action.

May this first edition of 'Science Days' not be an end in itself, but a new beginning – leading to more collaborative projects, innovative training programmes, socially engaged research and informed public policy.

To realise this ambition, several initiatives will follow immediately:

- on online evaluation and feedback questionnaire will be circulated; please do take the time to complete it, even briefly: your feedback will be invaluable in planning the next steps;
- the proceedings of 'Science Days' will be published and made available, including recordings, slideshows, posters and contributions intended for special issues of scientific journals;
- at the General Assembly in Nairobi, a dedicated space will showcase the 'Science Days' and offer opportunities for scientific discussion directly inspired by this experience.

I would also like to remind you that TSARA is open to any initiative put forward by its members — whether to improve, innovate or strengthen cooperation within the framework of this collective endeavour.

Finally, the National School of Agriculture in Meknès reaffirms its full commitment to working alongside all TSARA stakeholders to jointly realise this ambitious and necessary vision.

Thank you.

DEBRIEFING

i) A positive assessment for this first edition

▪ **In terms of mobilisation and partnership dynamics**

- importance of **the teamwork** carried out, strong mobilisation of TSARA partners for preparation and implementation (see Appendix 1);

- **diversity** of institutions present and countries represented, **significant participation** maintained without too many disconnections during the course of the sessions (see Appendices 3&4);

- useful milestone for **raising awareness of TSARA**, the work carried out and the partners involved, the added value of TSARA as a platform bringing together researchers, young and senior, from the South and the North, **strengthening the TSARA community**, **connecting** people, countries, actors and territories;

- **expressed willingness to continue** interactions/exchanges/engagement/collaborations in order to collectively translate discussions into concrete results (see § 3 and 4).

▪ **In terms of format and organisation**

- combination of **different sequences** (questionnaire, presentation of authors, round tables) constituting lively and dynamic sessions;

- **questionnaire sequences prepared and led by students** highly appreciated: interactive, innovative, playful, rich, informative, useful for opening sessions and providing an overview of the landscape (e.g.: table of initiatives, networks, projects related to agroecology); formula adopted in response to a tight schedule for preparing the "landscapes" with students ahead of Science Days; the absence of keynote speakers initially envisaged did not seem to pose a problem;

- good **technical and logistical management** in the face of the challenge of content density and the number of speakers (coordination of speakers, panels and plenary/parallel rooms);

- **smooth mobilisation** of all participants and speakers under the highly effective leadership of **the chairs and co-chairs;**

- **simultaneous translation** greatly appreciated;

- usefulness of the session chairs framing meeting to share questions and information and clarify any points that needed clarification.

▪ **In terms of content**

- **diversity, richness and concrete/practical dimension of the work presented**, points of view, research priorities and disciplines involved, in line with the wealth of responses to **the call for abstracts**;

- interesting, coherent, useful scientific topics and content, of good scientific quality, covering many aspects of each of the themes, showcasing the richness of the work done in the field, and well presented (contributions in terms of sustainability, resilience, food and nutritional security, local production; interesting simulation of different agroecological transition – AET- scenarios including financial investment aspects; cross-cutting, cultural and political dimensions of diets addressed with issues of nutrition, microbiota, food security);

-**4thsession** opening the floor to **various panelists***,* enabling *rich and forward-looking discussions, exchange of perspectives and practical recommendations was highly valuable, a meaningful learning*

experience, creating a constructive space for dialogue between science, policy, and practice [nuanced point of view below].

ii) Areas for improvement

▪ **Main difficulty: the density of the sessions, the number of presentations and therefore time management:**

- timing was ultimately more or less under control (20 minutes late for the first three sessions), but at the cost of **putting considerable pressure** on the chairs, co-chairs and round table moderators, who were forced to interrupt their colleagues, and therefore on the speakers, **with less time for** everyone **to express** themselves, expand on their presentations/comments and engage in dialogue;

- for some, the frustration of having to **choose one of the parallel sessions** (and perhaps an imbalance with more people staying in the plenary session and fewer switching to the parallel room/parallel session B);

▪ **Few questions** from the audience during the **Q&A** sessions in the parallel sessions (although this increased as the sessions progressed; perhaps the Q&A box could be more explained); the co-chairs prepared very well these Q&A sessions and supplemented with their own questions, which compensated for the lack of questions from the audience.

▪ **For the poster session**: the music was beautiful [Geoffrey Oryema, Land of Anaka, courtesy granted], but it would have been preferable for the authors to explain the poster as they went along, in 1 to 2 minutes [the initial idea behind the music was to provide a little quiet time];

▪ **Treatment of the subject of agroecological transition** and clarification of the link between agroecological transition and sustainable food systems, assessed differently with gaps: *6 to 7 principles of agroecology were presented, which is a good start / not all principles of agroecology were addressed; contribution of elements on the link between AET/SFS and on the link between agroecology and food security / link insufficiently demonstrated; environmental challenges insufficiently integrated into the sustainable food systems session (links between agriculture/nutrition/environment-biodiversity protection)*;

ii5) The 4th session was perceived by some as providing more content than a summary of the previous sessions and a clear identification of prospects.

iii) Follow-up

▪ **Evaluation and prospects questionnaire** for participants: it should be short, solicit feedback but focus mainly on prospects (what to do following the Science Days? How to plan for the next Science Days?).

▪ **Update on abstract authors** (who, where, what topics, what partnerships highlighted, what possible connections between authors), in addition to the update on registrants and participants (see Annexes 3 and 4).

▪ **Collective drafting of the Science Days Proceedings**, in the broadest sense, including: a written summary of each of the four sessions and a summary of the summaries with key messages in terms of science, partnership, prospects and recommendations; overview and details of participants; replays and slideshows of the four sessions; authors' summaries [to be reformatted and consolidated]; possibly a short film presenting the Science Days (~5' of excerpts from presentations?).

The proceedings should be finalised if possible in March, **ahead of the AGM in Nairobi** (13-15 May): to feed into the possible updating of TSARA's scientific agenda and action plan (particularly potential collaborative projects); during the AGM itself, time will be set aside for feedback on the Science Days; we are also planning scientific discussions that may be inspired by the lessons learned from the Science Days and explore certain issues in greater depth.

Everyone involved in the Science Days is asked to contribute to the proceedings: depending on the nature of their involvement and availability, we ask everyone to **indicate how they can contribute and/or to send in their contribution** (e.g. summary of a parallel session). NB: the importance and value for CVs of being listed among the authors of the proceedings is emphasised. The proceedings will be reviewed with the scientific committee.

The proceedings should enable**:**

- **highlight the collective work** carried out, with a particular emphasis on the added value of Science Days,

- everyone to review **the wealth of content** at their leisure and take stock of some of it (e.g. identify the principles of agroecology that were well addressed during the Science Days and those that were missing, and plan to discuss the significance of these gaps),

- identify content to be brought to the attention of policy makers, to be translated into **policy briefs**; identify content that could be the subject of **special issues**;

- mobilise **one or more groups of volunteers, bringing together senior researchers and students, to write one or more papers**; establish consortia between authors with shared interests; publication is a long-term process that requires the mobilisation of a motivated team (several colleagues have already volunteered);

- **communicate internally within TSARA**, liaise with researchers within our respective organisations, **and externally** (dissemination of proceedings, particularly on the TSARA website, publications).

▪ **Sustain and develop the network established with Science Days on the basis of and beyond TSARA**:

- **strengthen the existing TSARA collective** (36 members, some very active in Science Days, others less – to be discussed with them) and be **open to colleagues** wishing to join the initiative, get involved and contribute to the dynamic; exchange with European partners who attended Science Days to advance their involvement in TSARA;

- support **new collaborations** between authors whose work is similar, build **thematic networks, particularly for doctoral students**, and mentoring spaces;

- organise thematic exchanges, identify **content that can be shared** through "training"/webinars;

- use deliverables to support **project funding**; identify sources to fund student participation in this type of scientific exchange (effective here with the presentation of numerous student projects and the questionnaire slot) and joint student work formats.

iv) Lessons learned and ideas for future science days

▪ After this first edition, **the value of TSARA Science Days and the principle of organising them regularly have been validated** (among the proposals put forward: annual Science Days, and a scientific congress held in person and organized by TSARA every three years, potentially combined with the annual General Assembly).

▪ **Topics** to be addressed: focus on gaps, areas that were insufficiently covered or may have been overlooked during these first Science Days (thematic and methodological gaps); see also the raw results of the Session 4 survey (PJ).

Food for thought: **all TSARA-funded projects** should be asked to submit at least one abstract/presentation for these scientific days during /at the end the project. This might slightly extend the duration of the sessions, but would provide a mix of contributions from TSARA partners and those developed jointly as part of the initiative.

▪ **Programme and format**:

- a **less busy** programme**, leaving more time for in-depth discussion and exchanges/dialogue**, particularly during round tables, to allow panelists to express their views in greater depth;

- fewer **presentations** [assuming less diversity of views and inclusiveness]?

- - come up with **a theme for each Science Day**, focusing the presentations on an important question;

- **more parallel sessions** to allow more time for each presentation? **Or no parallel sessions** so that participants do not have to choose and can listen to all the presentations in a single plenary session? Opinions differ;

- not four **2.5-hour sessions**, but two **full days**? 8 am to 3 pm UTC, 11 am to 6 pm EAT for participants from Africa and Europe; more complicated for colleagues elsewhere in the world – see Appendix 3: America, Asia-;

- a **multi-stakeholder round table** (scientists, politicians) in each session to strengthen dialogue?

- **poster sequence**, if applicable, organised with commentary from the authors for 1-2 minute segments per poster, using existing interactive tools [to be specified]; one possibility would be to have online posters and one or more presentation sessions with for each (selected) poster, only 1 slide explaining why people should see the poster or the main result;

- no summary of previous sessions at each session, only at the last session (principle adopted for session 3 after noting redundancy in session 2);

- positioning during the year separate from **annual break periods** (end of the year for southern Africa, mid-year for northern Africa and Europe).

POST-SCIENCE DAYS QUESTIONNAIRE

Summary compiled with the assistance of https://assistant.numerique.gouv.fr/ based on responses to the online questionnaire (43 responses: 28 for the French version, 15 for the English version).

1. Expectations and objectives

- **Overall satisfaction**: Participants felt that the Science Days **met their expectations**, and in some cases even **exceeded** them.
    - **Clarification of strategic directions**: TSARA's objectives (scientific vision, partnerships, priority themes) were better understood.
    - **Networking opportunities**: Strengthening of links between researchers, institutions and disciplines (North-South, Europe-Africa).
    - **Diversity of expectations**:
        - Discovering ongoing research (e.g. agroecology, sustainable food systems).
        - Sharing of knowledge and identification of potential collaborations.
        - Involvement in practical projects (project development, training, publications).
- **Unmet expectations**:
    - Some participants felt there was a **lack of depth** on specific topics (e.g. the origins of TSARA, governance, sustainability in the broadest sense).
    - **Insufficient time** to explore discussions in greater depth or to present work (particularly for posters).

2. Scientific content

☑ **Strengths**

- **Rigour and quality**:
    - **Scientifically sound** presentations, with a variety of methodological approaches.
    - **Thematic diversity**: Agroecology, One Health, digital technology, climate change, food systems, etc.
    - **Interdisciplinarity**: Integration of different disciplines (social sciences, agronomy, ecology, etc.).
- **Relevance of topics**:
    - Topics aligned with **global challenges** (agroecological transition, food security, climate adaptation).
    - Highlighting **innovative work** (participatory research, modelling, local solutions).

🔍 **Areas for improvement**

- **Focus**:
    - **Narrow the scope** to avoid diluting the discussions. Proposals:
        - Group themes by **region** (Africa, Europe) or **discipline**.
        - Select **more targeted presentations** (e.g. a call for abstracts assessed by a scientific committee [Editor's note: this was indeed the case]).
    - **Topics to be strengthened**:
        - **Climate change adaptation** and **mitigation**.
        - **Digital agriculture** and **modelling**.
        - **Gender and agroecology** (better integration of gender issues).
        - **Public policy**: Country-by-country overview, quantitative assessment, involvement of decision-makers.
        - **Applied research**: Practical examples of the adoption of agroecological practices, lessons learnt (successes and failures).
- **Balance**:

- **Fewer presentations**, but **more in-depth** (e.g. 10–15 mins' presentation + 5–10 mins' discussion).
- **Greater representation** of African research and local researchers.

3. Format and organisation

☑ **Positive points**

- **Accessibility**:
  - The **virtual** format enabled **broad participation** (from a variety of institutions, and from African and European countries).
  - **Flexibility**: Sessions spread over several days to accommodate different time zones.
- **Structure**:
  - A **well-organised** programme, with a logical sequence of presentations.
  - **Plenary and parallel sessions** were appreciated for their complementary nature.

⚠ **Limitations**

- **Limited interaction**:
  - **Insufficient time** for discussions, Q&As and networking.
  - **A one-way format** (presentations 'one after the other') not conducive to spontaneous exchanges.
  - **Overcrowded sessions**: Difficulty in following all the presentations (particularly the posters).
- **Logistical issues**:
  - **Connectivity**: Technical difficulties for some participants (e.g. poor connection in Africa).
  - **Time zones**: Time slots not well suited to everyone (e.g. 12:00–15:00 UTC).
  - **Translation**: A need for more robust **translation facilities** to include non-English speakers.

💡 **Recommendations**

- **Hybrid format**:
  - Combine **in-person** (for informal discussions) and **virtual** (for accessibility).
  - Organise **parallel sessions** to cover more topics in depth.
- **Improve interaction**:
  - **Allocate more time** to discussions (e.g. 50 per cent of the time dedicated to Q&A and debates).
  - **Practical workshops**: Small-group work on real-world projects.
  - **Feedback sessions**: Share **successes and failures** to inspire participants.
- **Posters**:
  - Replace traditional poster sessions with **short presentations** (3–5 mins) followed by discussions.
  - **Assess the posters** and recognise the best ones (prizes, honourable mentions).
- **Duration**:
  - **2–3 consecutive days** (e.g. 08:00–15:00 UTC / 11:00–18:00 EAT) for African and European participants.
  - Alternative: **4 sessions of 2½ hours spread over 2 weeks** to avoid fatigue [Editor's note: this was the format used for these Science Days].

4. Partnerships and collaboration

☑ **Successes**

- **Strengthening ties**:
  - Strengthened **institutional partnerships** (universities, research centres, NGOs).
  - **North-South** and **interdisciplinary collaborations** (e.g. co-authoring articles, joint projects).

    - **Networking**: Identification of potential partners for future projects.
- **Diversity of stakeholders**:
    - Involvement of **researchers, policy-makers, industry representatives, farmers** and **students**.

🔍 **Areas for improvement**

- **Post-event follow-up**:
    - Establish **thematic working groups** (e.g. agroecology, water, One Health) with **clear roadmaps** [Editor's note: this will be done as part of the relaunch of the Thematic Task Forces (TTFs)]
    - **Facilitating access to funding**: Compile a list of funding bodies and funding opportunities (e.g. Horizon Europe, local calls for proposals).
    - **Directory of participants**: Circulate a **list of participants** (with keywords, publications, contact details) to encourage collaboration.
- **Inclusion**:
    - **Involve young researchers** (PhD students, postdoctoral researchers) **more closely** through **dedicated sessions** or mentoring.
    - **Involving farmers**: Giving them a platform to share their **views and needs**.
    - **Gender balance**: Ensure **equitable representation** of women in presentations and the organisation [Editor's note: this aspect was taken into account during these 1st Science Days]
- **Technical and financial partnerships**:
    - **Mobilise more funders** (public and private).
    - **Collaborate with local stakeholders** (e.g. CILSS, farmers' organisations).

5. Overall strengths

- **Scientific quality**: High standard of presentations and discussions.
- **Diversity**:
    - **Thematic**: A wide range of topics covered.
    - **Geographical**: Participation of researchers from **several continents** (Africa, Europe, the Americas).
    - **Institutional**: Involvement of **universities, research centres, NGOs and industry**.
- **Strategic clarity**: A better understanding of **TSARA's priorities** and **potential synergies**.
- **Commitment**: Strong momentum generated within the TSARA community.

6. Next steps

📄 **Publications and dissemination**

- **Conference proceedings**:
    - Publish **scientific articles** (peer-reviewed) in a dedicated collection (e.g. HAL).
    - Produce a **white paper** or a **summary of the key findings**.
    - Publish the **presentations and summaries** on a shared platform (e.g. the TSARA website).
- **Communication tools**:
    - **Quarterly newsletter**: Updates on projects, calls for proposals, opportunities for collaboration.
    - **Collaborative platform**: A space for sharing data, publications and tools.

🎓 **Capacity building**

- **Training**:
    - Workshops on **project proposal writing**, **data analysis** and **modelling**.
    - **Summer schools** or **online courses** on key topics (e.g. participatory agroecology).
- **Mentoring**:
    - Programmes for **early-career researchers** (mentoring by senior researchers).

🤝 **Structuring collaborations**

- **Working groups**:
  - Set up **thematic groups** (e.g. agroecology, water, One Health) with **regular meetings**.
  - Organise **thematic webinars** to maintain momentum.
- **Joint projects**:
  - **Internal calls for proposals** to fund emerging collaborations.
  - **Partnerships with funders**: Identify funding opportunities aligned with TSARA's themes.

🌍 **Science-policy interface**

- **Involvement of decision-makers**:
  - Organising **sessions dedicated** to public policy (country-specific presentations, debates).
  - Establish a **'science-policy' working group** to facilitate dialogue.
- **Advocacy**:
  - **Raise awareness amongst institutions** (governments, NGOs) of the importance of agroecological research.

7. Frequency

- **Majority preference**: **Annual** (to maintain momentum).
- **Alternative**: **Biennial** (to allow for **more thorough preparation** and a greater impact).
- **Other proposals**:
  - **Quarterly sessions** (themed webinars).
  - **Regional events** (e.g. Science Days by geographical area).

8. Personal implications

- **Participant commitment**:
  - **Willingness to get involved** in **TSARA's thematic groups** (e.g. agroecology, One Health, digital).
  - **Proposed contributions**:
    - Participation in **collaborative research** projects.
    - Organisation of **webinars** or **workshops**.
    - Development of **joint projects** (planning, funding).
    - **Training**: Facilitating sessions or providing mentoring.
    - **Science-policy interface**: Contributing to discussions and drafting proposals.
- **Individual expectations**:
  - **Recognition**: Some people request **certificates of attendance** or **certificates** of participation.
  - **Access to resources**: Sharing of **presentations, proceedings and contact details** to facilitate collaboration.

📊 **Conclusion and key recommendations**

Aspect	Strengths	Priority improvements	Concrete actions
Content	Multidisciplinarity, rigour	More focused themes, selected presentations	Call for abstracts, scientific committee, inclusion of emerging themes (gender, digital).
Format	Accessibility (virtual)	Hybrid, parallel sessions, extended duration	2–3 hybrid days, practical workshops, flash presentations for posters.

Aspect	Strengths	Priority improvements	Concrete actions
Partnerships	Networking, new collaborations	Structured follow-up, inclusion of early-career researchers	Working groups, participants' directory, mentoring.
Equity	Diversity of participants	Greater African and gender representation	Quotas, translation, sessions dedicated to local researchers.
Outputs	Fruitful exchanges	Publications, reports, training courses	Conference proceedings, newsletter, collaborative platform, training workshops.
Frequency	Annual cycle	Balance between frequency and depth	Annual event + quarterly webinars.

Next steps for TSARA:

1. **Refine the focus** of Science Days (thematic or regional).
2. **Improve engagement** through hybrid formats and in-depth discussions.
3. **Sustaining momentum**:
    - Set up **thematic working groups**.
    - Organise **follow-up webinars**.
    - Publish **proceedings and summaries**.
    - **Train and mentor** young researchers.

Final message: The TSARA Scientific Days have **succeeded in bringing together a committed community** focused on agroecology and sustainable food systems. To **build on this success**, it is essential to **organise follow-up activities** (publications, working groups, training) and **to adapt the format** to maximise dialogue and impact.

I. INTRODUCTIONS, SYNTHÈSES & CONCLUSIONS (français)

RÉSUMÉ

TSARA est une initiative de recherche partenariale visant par la mise en réseau, le partage de savoirs et de pratiques et la co-construction de projets, à accompagner la transformation vers des systèmes alimentaires productifs, résilients, durables et inclusifs, contribuant à la sécurité alimentaire et nutritionnelle et à la création de valeur et d'emplois, tout en préservant les ressources et la santé globale.

Dans cette perspective, les 1ers TSARA Science Days organisés en virtuel en janvier 2026 avaient pour objectif i) le partage de connaissances en matière de transition agroécologique, de systèmes alimentaires durables et d'interactions entre agroécologie et systèmes alimentaires, ii) le dialogue entre chercheurs sur la base de leurs travaux concrets, la consolidation et l'ouverture de la communauté scientifique TSARA, iii) l'identification et la discussion de pistes à travailler.

Ils ont rassemblé plus de 400 participants dont 71 porteurs de projets, doctorants ou chercheurs seniors, Africains et Européens, travaillant dans de nombreuses disciplines et thématiques.

Participants, auteurs et experts ont convergé quant aux approches à développer et leviers à promouvoir pour avoir l'impact recherché.

L'agroécologie, approche systémique associant un ensemble de pratiques agricoles mais aussi objet de gouvernance territoriale, est considérée comme un **levier opérant de transformation des systèmes alimentaires** : valorisation des savoirs locaux, action collective et co-construction de stratégies adaptées au territoire, pratiques de production respectueuses de l'environnement, utilisation efficiente des ressources, renforcement de la résilience, amélioration de l'équité sociale, circuits courts et valorisation des produits locaux, orientation des modes de consommation, renforcement de l'autonomie des territoires et relocalisation des filières.

Une diversité de pratiques agroécologiques sont présentées - diversité génétique animale et végétale, diversification des productions et des activités, santé du sol, des plantes et des animaux, lutte biologique et biocontrôle, pastoralisme, gestion de l'eau, circularité, …-, sous l'angle de la modélisation, de l'épidémiologie, de la génétique, … Le changement et la variabilité climatiques sont explorés dans la majorité des travaux présentés.

En matière de systèmes alimentaires sont présentés des innovations, des pratiques, des technologies, des produits, des procédés, des stratégies et des politiques qui contribuent à l'amélioration de la sécurité alimentaire et nutritionnelle : transformation de produits végétaux et animaux, incluant légumineuses et insectes comestibles, fermentation, congélation, alimentation infantile, technologies post-récolte, chaîne du froid, développement de marchés, gestion de l'eau, commerce et interconnexions entre alimentation, eau et énergie.

Pour accompagner efficacement la transformation vers des systèmes alimentaires durables, différents leviers sont à activer et articuler :

- **gouvernance multi-acteurs** à même de coconstruire les trajectoires à l'échelle des territoires de façon inclusive, reliant producteurs et consommateurs ;

- **écosystèmes de connaissances participatifs** associant recherche, formation, acteurs de terrain et institutions publiques, articulant savoirs locaux et savoirs scientifiques ; la recherche pouvant jouer un rôle d'éclairage des choix et de médiation ;

- **approfondissement scientifique** en matière de principes et de performance de l'agroécologie, mécanismes de partage des risques, approches multidimensionnelles et multidisciplinaires de l'alimentation et des compromis entre les dimensions culture- économie-environnement- court et long termes-genre, lien agrobiodiversité-nutrition-microbiote, interfaces entre démarches participatives et outils de modélisation pour accompagner les processus décisionnels, technologies et données numériques adaptées ;

- **développement du dialogue et des interfaces science-politique** en soutien à des politiques cohérentes, coordonnées et favorables ;

- **renforcement de la formation, pour l'ensemble des acteurs**, initiale et continue, en matière d'agroécologie, approche systémique, articulation entre alimentation, nutrition et environnement, systèmes multicritères adaptés.

TSARA a vocation à s'emparer de ces orientations. « Communauté de recherche, plateforme, hub de connaissances et d'expertises », TSARA doit, en réseau et en synergie avec l'existant :

- conforter son approche de **recherche participative à la fois globale et ancrée localement** s'appuyant sur des living labs,

- développer l'axe **formation**, l'implication et le soutien aux étudiants,

- penser **synthèse de ces résultats et communication**, en diffusant ces résultats à une large communauté ;

- s'attacher à l'**interface science-politique** à différentes échelles, notamment dans le cadre du dialogue Union Africaine-Union Européenne, vis-à-vis des gouvernements africains, des partenaires multinationaux ;

- contribuer à **convaincre décideurs et secteur privé** de l'importance de soutenir la recherche et obtenir des **financements** ;

- poursuivre et amplifier la proposition d'**espaces d'échange scientifique et interacteurs**.

Le bilan est positif pour cette première édition des TSARA Science Days en matière de i) mobilisation et de dynamique partenariale (travail d'équipe, participation importante et diversifiée, interconnaissance et renforcement de la communauté TSARA, volonté de poursuivre), ii) format et organisation, iii) contenus (diversité thématique et disciplinaire, richesse, intérêt et dimension concrète des travaux présentés, surtout concernant l'agroécologie, moins sur l'interaction entre agroécologie et systèmes alimentaires). Sont jugés perfectibles la forte densité des sessions, la pression sur la gestion du temps et la moindre place aux échanges.

Les suites attendues portent sur la consolidation de communautés de pratiques, le développement de nouvelles collaborations entre auteurs, la construction de réseaux en particulier de doctorants, l'organisation d'échanges thématiques, la valorisation des contenus (publications, groupes de travail, formations).

Les prochains Science Days sont plébiscités : en format présentiel (ou hybride) sur plusieurs jours, au bénéfice d'interactions et d'échanges approfondis, avec partage d'expérience, ateliers de travail sur des projets, remise de prix ; pour un public multi-acteurs - recherche publique et privée, étudiants, agriculteurs, société civile, décideurs, bailleurs- ; sur les thèmes par exemple de l'adaptation au changement climatique, l'agriculture numérique, l'emploi agricole, la préservation de la biodiversité, la gestion de l'eau/ReUSE, O*ne Health* pour la sécurité alimentaire, l'évaluation des politiques publiques.

1. INTRODUCTIONS

1.1. OBJECTIFS, STRUCTURATION & PARTICIPANTS

Présidente de la session 1 :
Sonia Bedhiaf-Romdhani, INRAT, Tunisie



i) Objectifs

L'initiative TSARA se développe au travers de son agenda scientifique collectif (approuvé par l'Assemblée générale en 2024), mais aussi et surtout des recherches collaboratives menées dans les différents domaines thématiques, qui contribuent à l'objectif commun des membres de TSARA de « **transformer les systèmes alimentaires et l'agriculture** » grâce à de nouvelles connaissances, des cadres analytiques, des méthodes et des innovations transformatrices.

En proposant les premières Journées scientifiques TSARA (en visioconférence), le secrétariat de l'initiative[3] poursuit trois objectifs spécifiques : i) **favoriser le dialogue entre chercheurs sur la base de leurs travaux concrets**, qu'ils s'inscrivent dans le cadre de projets ciblés ou d'ampleur ; ii) de faire le point sur l'état d'avancement de la mise en œuvre de l'initiative, **de clarifier ensemble ce qu'est réellement la recherche TSARA** et comment elle s'inscrit dans le paysage, d'identifier les lacunes sur lesquelles nous devrions concentrer notre attention à l'avenir, et d'identifier des **perspectives en termes de recherche, d'actions et de projets à mener** ; iii) **de consolider et d'ouvrir la communauté scientifique TSARA**, en renforçant la visibilité de ses travaux tant au sein du monde de la recherche internationale qu'au-delà. Les Science Days constituent une occasion unique de consolider la dimension scientifique de l'initiative, tant en interne qu'en externe.

Le secrétariat, appuyé par un comité de pilotage et un comité scientifique, a décidé d'axer cette première édition des Science Days sur trois thèmes : **la transition agroécologique, les systèmes alimentaires durables et les interactions entre l'agroécologie et les systèmes alimentaires**.

Dans le cadre de **la transition agroécologique**, il s'agit de rassembler et faciliter le dialogue entre les projets de recherche qui favorisent la **mise en œuvre des principes agroécologiques**, tels que les recherches sur **les freins et les moteurs** de la transition, la fonctionnalité des sols, la réduction des intrants, la diversification des activités et l'intégration de la sylviculture, des cultures et de l'élevage, la conservation de l'eau, la santé des végétaux, des animaux et de l'environnement, la coproduction de connaissances, le développement des systèmes alimentaires locaux, la création d'emplois, les transformations numériques, etc.

Les systèmes alimentaires durables peuvent être abordés, par exemple, à travers la recherche sur la valorisation des **ressources locales** et la réduction des pertes et du gaspillage, l'étude des relations

[3] La gouvernance de TSARA est assurée par i) une assemblée générale (AG) constituée des directeurs généraux des institutions membres, ii) un secrétariat qui met en œuvre les décisions de l'AG et assure le suivi des activités en matière de science-projets-partenariat-gouvernance-communication, iii) 9 task forces thématiques, collectifs de scientifiques qui font vivre le socle de TSARA, iv) un comité consultatif externe (CCE).

entre l'alimentation et la **santé** humaine, la différenciation des **marchés** et la répartition de la valeur ajoutée dans les chaînes de valeur, la création d'**emplois**, le rôle et les méthodes de la **transformation agroalimentaire**, les transformations **numériques**, la **gouvernance** des systèmes alimentaires, etc.

Sont également attendues et prises en compte les contributions qui établissent un **lien entre les principes de l'agroécologie** (santé des sols, biodiversité, recyclage, réduction des intrants, connectivité, etc.), le fonctionnement des **systèmes alimentaires** (production, transformation, pertes, environnement, comportement des consommateurs, chaînes de valeur, etc.) et les résultats des systèmes alimentaires (durabilité environnementale et socio-économique, sécurité alimentaire, nutrition et santé).

ii) Structuration

Pour ces 1ers Science Days, sont donc abordées des recherches collaboratives qui contribuent aux transitions agroécologiques, à la durabilité des systèmes alimentaires, et qui s'attachent aux interactions entre l'agroécologie et les systèmes alimentaires.

Les sessions 1 à 3, qui se sont tenues les 13, 15 et 20 janvier (**Transition agroécologique, Systèmes alimentaires durables, Interactions entre ces deux approches**), étaient structurées comme suit :

a. **établissement du « paysage »** dans lequel s'inscrit TSARA sur le thème de la session, par des doctorantes, de manière interactive avec les participants ;

b. **présentation de projets menés dans le cadre de TSARA et/ou en lien avec TSARA**, en réponse à un appel à communications ; les propositions reçues sont nombreuses et variées en termes de thèmes, d'approches et de portée ; elles sont présentées lors de deux sous-sessions parallèles ;

c. **synthèse et perspectives**.

La session 4, le 22 janvier, est consacrée à une synthèse des trois sessions précédentes, à une discussion participative de cette synthèse et **à une mise en perspective à travers deux tables rondes visant à dégager des orientations et des pistes de recherche, d'actions et de projets à mener**.

iii) Participants : auteurs et public

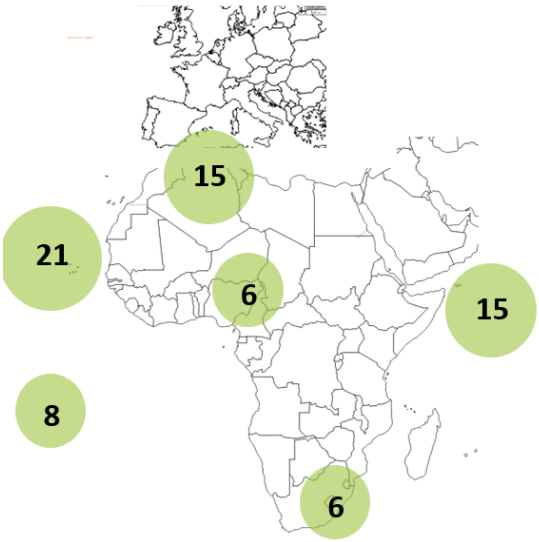
Suite à l'appel à communications, **71 propositions** ont été retenues par le comité scientifique et orientées vers des présentations de 10', 5' ou sous forme de posters.

Animateur du Comité scientifique :

Benoît Dedieu, INRAE, France



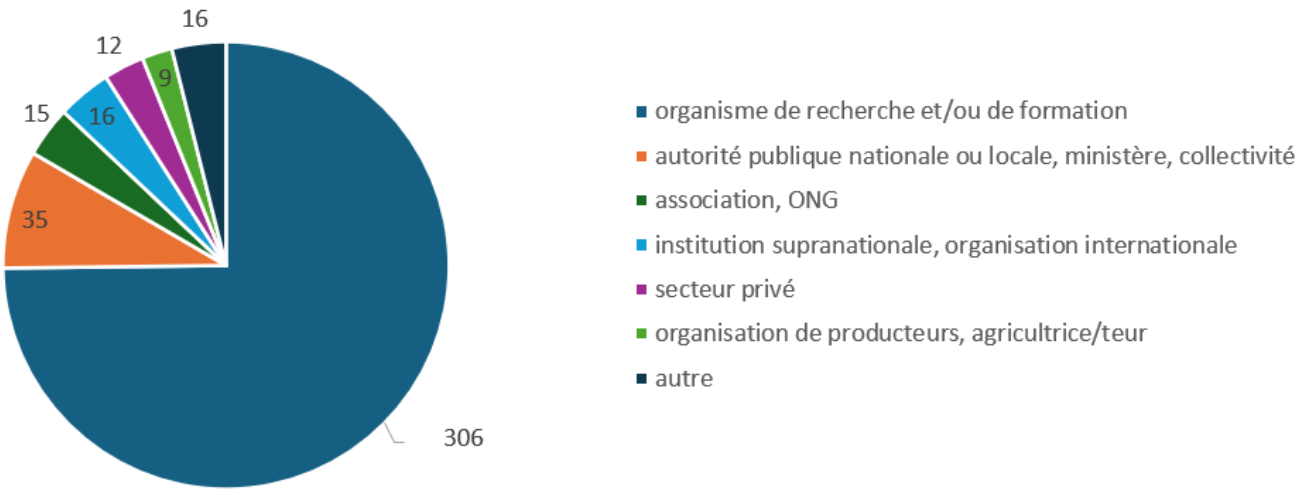
Les travaux se déroulent dans de nombreux pays, en Afrique de l'Ouest, de l'Est, Australe, Centrale, ou à l'échelle du continent africain, et ils s'attachent à une grande variété de thématiques.





Concernant les participants :

- **424 participants au total** (personnes distinctes connectées à une ou plusieurs session(s))
- issus de **43 pays, africains, européens, mais aussi d'Amérique latine et du Nord, et d'Asie**
    - Plus de 20 participants : France, Maroc, Sénégal
    - Entre 20 et 10 participants : Bénin, Ethiopie, Tunisie, Cameroun, Burkina Faso, Côte d'Ivoire, Madagascar
    - Entre 9 et 2 participants : Kenya, Mali, Afrique du Sud, Congo RDC, Ghana, Togo, Algérie, Canada, Nigéria, Zimbabwe, Italie, Pays-Bas, Tchad, Uruguay, Allemagne, Guinée, Namibie, Ouganda, Zambie
    - 1 participant : Bolivie, Brésil, Comores, Congo-Brazzaville, Danemark, Inde, Roumanie, Slovénie, Soudan, Suède, Tanzanie, Royaume-Uni, Etats-Unis, Vietnam
- et de **180 institutions dont 75% sont des organismes de recherche ou de formation** ; ministères, organisations internationales, ONG, secteur privé, organisations de producteurs sont également représentés :

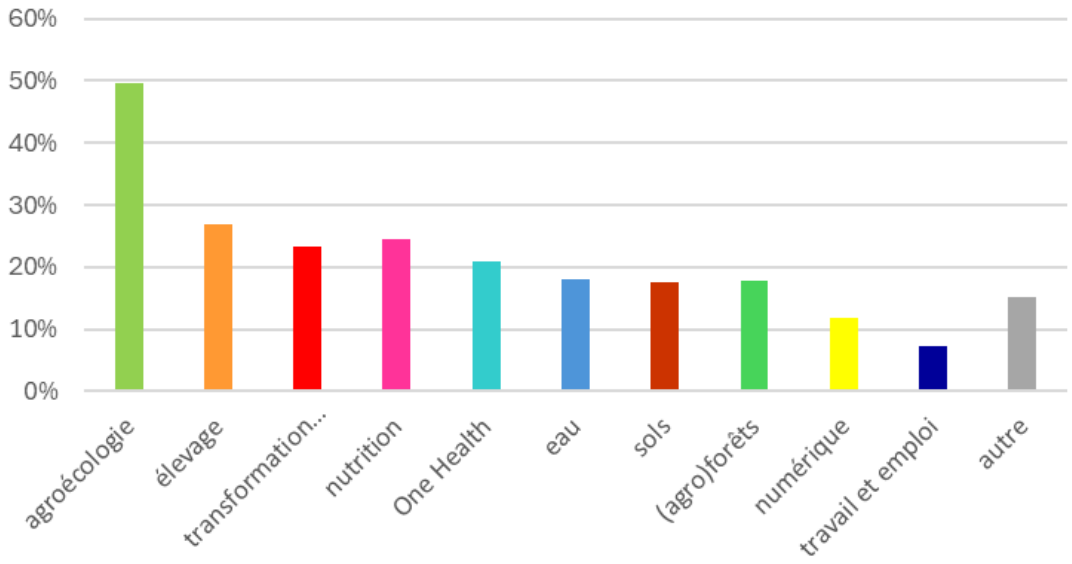


En termes de **participation aux différentes sessions :**

- **13%** des participants ont participé aux **4 sessions**, 14% à 3 sessions, 28% à 2 sessions, **46% à une session** ;

- les sessions ont chacune rassemblé respectivement : **245** participants (session 1), 219 (session 2), 179 (session 3), **176** (session 4).

▪ **L'agroécologie** est citée par 50% des participants comme thématique de travail (non exclusif), l'ensemble des thématiques au cœur de l'agenda scientifique sont citées (% de participants citant chaque thématique) :



1.2. OUVERTURE

Jean-Paul Laclau, DGDRS – Direction Générale Déléguée à la Recherche et à la Stratégie, Cirad, France, représentant la PDG coprésidant TSARA



Je vous remercie pour l'invitation à ouvrir les 1ères journées scientifiques de l'initiative TSARA. Je représente ici la PDG du Cirad, Elisabeth Claverie de Saint-Martin, qui assure la co-présidence tournante de l'initiative en ce moment, avec le directeur de l'ENA Meknès, le professeur Saïd Amiri qui clôturera ces journées scientifiques.

1. Remerciements aux nombreux organisateurs. Cet évènement a pour objectif principal de consolider une communauté scientifique impliquée dans l'initiative TSARA.

Ces journées scientifiques ont été imaginées lors de la seconde assemblée générale de TSARA au Sénégal en 2024, réellement décidées lors de la 3eme AG en France en 2025, et elles seront valorisées lors de l'AG de Nairobi en mai prochain. L'ensemble des membres de TSARA a soutenu le lancement de Journées scientifiques lors de ces AG.

Une cinquantaine de personnes de différents pays ont été fortement engagées dans l'organisation de ces journées, que ce soit au niveau du secrétariat de TSARA, du comité scientifique, du comité de pilotage des journées mais aussi pour la relecture des nombreuses propositions de communication.

2. Remerciement à l'ensemble des intervenants, et aux participants, qui ont envoyés des propositions de communications, qui animent des sessions, qui sont mobilisés comme grands témoins, et bien sûr toutes les personnes qui assistent à ces journées.

La participation à ces journées est un réel succès avec plus de 80 orateurs et environ 650 inscrits provenant de 65 pays et plus de 300 institutions. De nombreuses communications concernent l'agroécologie mais les participants s'intéressent à toutes les thématiques de TSARA.

3. TSARA a pour ambition d'apporter un appui aux politiques publiques, tout en contribuant aux grandes initiatives internationales qui associent l'Afrique, l'Europe et les autres continents dans les domaines de l'agriculture, de l'alimentation et de l'environnement.

TSARA est un consortium de recherche, de formation et d'innovation en partenariat, destiné à partager des connaissances, des méthodes, des réseaux, et à co-construire des programmes et des projets de recherche.

4. Le Cirad est fortement impliqué dans TSARA. Cette initiative contribue à notre stratégie scientifique et partenariale pour la transformation des systèmes alimentaires. Les thématiques retenues pour les 4 sessions de ces journées, autour de la durabilité des systèmes alimentaires et des transitions agro-écologiques, sont au cœur de nos engagements avec nos partenaires. Le Cirad partage l'ensemble des finalités de TSARA. Il est en particulier important pour nous que les membres de l'initiative aient une vision partagée sur les principaux enjeux socio-économiques et environnementaux et leur implication en termes de recherche agronomique.

Ces journées s'annoncent particulièrement denses et intéressantes. Je vous souhaite des échanges fructueux pour qu'elles atteignent pleinement leur objectif de consolidation d'une communauté scientifiques TSARA.

Je vous remercie.

1.3. L'INITIATIVE TSARA

Marie Schill, cheffe de projet TSARA à INRAE, France



i) TSARA, pour quoi ?



Le contexte dans lequel s'inscrit TSARA est celui des enjeux globaux, particulièrement prégnants en Afrique, que sont la démographie, le changement climatique, des ressources limitées. Il exige de trouver et atteindre une forme de **performance qui soit à la fois économique, écologique et sociale** ; de créer de la valeur et des emplois, de valoriser les ressources locales, et de travailler notamment l'axe de la circularité pour **faire plus avec moins**.

C'est une tâche très complexe qui demande de **mobiliser la recherche**.

Une recherche :

- qui permette de **coconstruire de la connaissance pour comprendre et caractériser nos systèmes**, afin de trouver des solutions ;

- qui s'attache notamment à des **interfaces**, à des **nexus**, mobilisant de nombreuses **disciplines**, agissant dans une forme de **synergie**, de **complémentarités**, maîtres mots dans TSARA ;

- qui travaille dans un **partenariat équilibré** devant réduire l'asymétrie de moyens existant entre continents et nos pays ;

- qui porte une attention particulière aux **futurs acteurs que sont les jeunes**, à travers notamment la **formation**.

ii) TSARA, un partenariat

TSARA compte 36 membres, issus de 17 pays, répartis sur l'ensemble du continent africain et en Europe – à ce stade en France.



[En octobre 2026, TSARA compte 39 membres, l'Université de Nairobi-au Kenya, USSEIN - Université du Sine Saloum El-Hâdj Ibrahima NIASS – au Sénégal, et UASZ- Université Assane Seck Ziguinchor – au Sénégal ayant rejoint l'initiative].

iii) TSARA un continuum recherche, projets, partenariat, décision

TSARA est le cadre de **réflexions et d'échanges scientifiques** qui se concrétisent à travers des **projets** qui mobilisent des partenaires et des réseaux et peuvent aller jusqu'à s'adresser aux autorités publiques dans une forme de diplomatie scientifique.



Nous comptons aujourd'hui dans TSARA **plus de 70 activités co-financées**, dont des **thèses, des événements scientifiques, des projets collaboratifs de recherche**. Ces activités portent sur de nombreux sujets en rapport avec l'agenda scientifique de TSARA qui compte 9 thématiques souvent interconnectées - agroécologie, eau, sols, (agro)forêts, élevage, nutrition, One Health, travail, numérique - ; elles mobilisent des méthodes également très variées, avec notamment une place importante de la génétique et de la modélisation, en prise avec le changement climatique.

iv) Quelques exemples de pôles à la fois fédérateurs et opérationnels

Sur le sujet majeur du **travail et de l'emploi**, en lien avec la question essentielle de la jeunesse, la conférence internationale organisée à Dakar en janvier 2025 a montré un **fort besoin de données pour documenter des politiques qui soient réellement efficientes en matière d'emploi décent** et fait l'objet d'une attention soutenue des autorités sénégalaises.



Autour des **systèmes alimentaires, de la nutrition et de la transformation**, les exemples sont nombreux, allant **du microbiote aux politiques publiques**, traitant de **conservation** par exemple avec le froid, des **marchés**, de filières particulièrement présentes comme les **légumineuses**.



FAMA – food and microbiota in Africa
Numiscol
Produits halieutiques traditionnels **fermentés**

Sélection arachides – acides aminés
Légumineuses et farines **infantiles**
Plantes **locales** et lactation

Lait vecteur de développement
MIPCLAN – **élevage** et GES

AFRICOLD – froid low cost

Marchés territoriaux - intermédiations bio/agroécologie
Food & migration

Santé
Local
Valorisation
Énergie

Autour de la **triple performance**, de l'**agroécologie** et de l'approche **One Health**, des projets s'attachent par exemple aux abeilles, mobilisent épidémiologie, modélisation, génétique.



Abeilles et agroécologie

MARA – **modélisation**, ravageurs, agroécologie
Épidémiologie de la brûlure bactérienne du niébé
Ghanagref - porte-greffes, **sélection**, résistance aux maladies de la tomate
Diagnet - diagnostic des maladies du riz
Ectoparasites – gestion intégrée de la santé bovine
Phenoticks – nouveau **phénotype** de résistance aux tiques

Races locales et résilience - 3 webinaires - **CBBP**

Triple performance
Agroécologie
« One Health »

La question de **l'eau, des points de vue quantitatif, qualitatif, de la ReUSE** en lien avec la thématique croissante de la **circularité**, du lien au **digital**, est également présente, mobilisant souvent des approches caractéristiques de TSARA, **multi-acteurs et living labs**.



MORFeus - solutions **nexus eau-énergie-alimentation-écosystèmes** pour des territoires méditerranéens résilients
AQUEDUCT - interconnexion hydrologique au sein des bassins versants méditerranéens
MAHDIA – nexus eau, alimentation, TAE

ReUSE – optimisation via les outils du numérique

Nexus
Living labs
Circularité
Plus avec moins

v) Échanger, partager et avancer ensemble

TSARA trouve ensuite son sens stratégique par des temps d'échanges, de dialogue, dans différents formats, de différents registres, à différentes échelles, dont voici trois exemples.

L'humain au centre, se rencontrer dans notre diversité



Un format scientifique propre à TSARA avec le **Séminaire inter-TFT** (task forces thématiques) qui s'est tenu en décembre 2024 à l'ENA de Meknès au Maroc, où nous avons échangé sur la notion de « sciences transformatives », réfléchi aux possibilités de synergies entre actions menées, et au montage de projets.



Un format scientifique ouvert, avec les présents et **1ers TSARA Science Days.**



Un format plus institutionnel avec le jalon important pour TSARA de notre **4ème AG organisée en mai 2026 à Nairobi adossée au Sommet Africa forward et à laquelle seront associés des temps d'**échanges scientifiques et de visites de laboratoires et de terrain.

Plus d'information sur TSARA : plaquette et site internet.

2. SYNTHÈSES DES SESSIONS

2.1. SESSION 1 : TRANSITION AGROÉCOLOGIQUE

Présidente :
Sonia Bedhiaf-Romdhani, INRAT, Tunisie



La session 1 a posé les fondements conceptuels, en mettant en évidence une compréhension largement partagée de l'agroécologie comme une approche holistique intégrant durabilité environnementale, résilience, équité sociale et sécurité alimentaire. Les participant(e)s ont souligné son rôle central face aux crises climatique, écologique et alimentaire, tout en identifiant des défis scientifiques majeurs, notamment le changement d'échelle, la mesure des impacts à long terme et l'articulation entre savoirs scientifiques et savoirs locaux.

i) Établissement participatif du « paysage »

Animation :
Khadija Jaafary
& Wiam Moumen, IAV, Maroc





130 personnes ont participé à l'enquête en ligne « Wooclap », 60 % d'hommes et 40% de femmes. La tranche d'âge 40 – 54 ans est médiane.

- A la question : « en un mot **comment définiriez-vous l'agroécologie / son objectif principal ?** », les réponses sont très nombreuses ! Dominent les termes « sustainability / durabilité » puis « environnement », « biodiversité », « résilience ».

- Quelles sont les **principales limites et barrières à la mise en œuvre de l'agroécologie dans votre région ?** Les réponses proposées les plus validées sont dans l'ordre : le manque de formation et d'accompagnement (50 % des votants) ; les rendements perçus comme inférieurs (45 %) ; des politiques publiques peu favorables (43 %) ; les incertitudes techniques et économiques (40 %). Les besoins accrus en main-d'œuvre (34 %) et le manque de débouchés (16 %) sont moins cités.

- Quel est selon vous **le plus grand défi scientifique actuel de l'agroécologie ?** Les réponses proposées les plus validées sont dans l'ordre : concevoir des systèmes multicritères adaptés (44 % des votants) ; mesurer les performances et impacts à long terme (40 %) ; comprendre les interactions écologiques complexes (36 %) ; changer d'échelle parcelle - territoire - pays/région (36 %). L'intégration des outils numériques vient bien loin derrière (17 %).

- **En agroécologie, quel est le compromis le plus difficile à équilibrer ?** La réponse proposée la plus validée est d'abord, et de loin, l'équilibre entre viabilité économique et responsabilité environnementale (48 % des votants). Puis viennent l'équilibre entre productivité et conservation des

écosystèmes (37 %) et celui entre connaissances scientifiques et savoirs des agriculteurs (34 %). Puis viennent les résultats à court terme vs la durabilité à long terme (28 %) et enfin la standardisation des pratiques vs leur adaptation aux contextes locaux (26 %).

- Selon vous, **quels sont les principaux besoins en matière de formation en agroécologie dans votre pays** (formation académique et formation des acteurs locaux) ? Les réponses étaient libres mais proposées continent par continent.

En Afrique du Nord, on retrouve plusieurs des éléments évoqués ci-dessous, comme les enjeux qui portent à la fois sur la formation professionnelle et continue avec un élargissement aux formations universitaires, avec une vision appliquée, adaptée aux challenges climatiques locaux. Les thématiques d'approfondissement relevées concernent les écosystèmes, la commercialisation des produits et les circuits courts, les interactions et bénéfices du couplage cultures-élevage, les bonnes pratiques agroécologiques, la gestion de l'eau. Il faut aussi sensibiliser la société, renforcer l'interaction entre scientifiques et décideurs politiques, enfin former les porteurs d'enjeux aux bénéfices de l'agroécologie.

En Afrique centrale et de l'Est, les participants soulignent aussi le manque de parcours de formation en agroécologie, de cursus spécialisés et de formation continue, avec tous les acteurs concernés. L'enjeu de la formation agroécologique est qu'elle concerne des agriculteurs (y compris au plaidoyer), les porteurs d'enjeux locaux, les cursus académiques pour une expertise qualifiée qui puisse articuler les défis de recherche, concevoir des expérimentations, analyser les données et les interpréter. La dimension institutionnelle et politique ne doit pas être oubliée, ainsi que le besoin de supports financiers. D'un point de vue plus thématique, la restauration des terres est citée de façon spécifique.

En Afrique de l'Ouest, on retrouve ces enjeux de formation professionnelle à universitaire, ouverte aux acteurs locaux mais aussi les enjeux de sensibilisation des décideurs politiques. La formation des techniciens agricoles est très citée, avec la nécessité de changer de posture (actuellement descendante). La formation universitaire doit intégrer les apports de la modélisation, des sciences de la complexité, la pratique transdisciplinaire. Les thématiques d'approfondissement sont nombreuses : accès au marché et plus-value des produits ; business model ; l'évaluation des risques sanitaires et environnementaux ; la valorisation des savoirs locaux ; les techniques de production des bio-intrants et plus largement les alternatives aux intrants conventionnels ; les méthodes de recyclage ; la prise de décision collaborative, la promotion des coopératives. Ces ambitions nécessitent des supports financiers qui ne sont pas suffisamment importants actuellement, et aussi pour les agriculteurs qui s'engagent dans la transition agroécologique, des subventions ciblées.

En Europe, il s'agit de former à l'agroécologie à tous les niveaux de formation, et de proposer des sessions de formation continue auprès des agriculteurs. L'évolution des compétences des conseillers, des métiers de l'alimentaire est aussi en question, tout comme la sensibilisation des porteurs d'enjeux locaux et des politiques à l'agroécologie. Plusieurs thématiques d'approfondissement sont évoquées telles que la biodiversité, la génétique, la santé des sols, les comportements des cultures hors des trajectoires optimales pour lesquelles elles sont été sélectionnées. Mais il s'agit surtout de transformer les façons de former, conseiller, accompagner, avec un dialogue entre experts et agriculteurs, des approches participatives multi-acteurs, des échanges entre producteurs, des démonstrations de solutions fondées sur la nature et des visites de fermes avec de bons résultats. Le pragmatique, l'acceptation de la réalité telle qu'elle est. Les approches holistiques et multidisciplinaires sont nécessaires, ainsi que le développement d'outils d'évaluation spécifiques à l'agroécologie.

- Pouvez vous partager **des exemples de réseaux, d'initiatives ou de projets liés à l'agroécologie ?**

La liste des réseaux et projets cités n'est pas reprise ici : ils sont très nombreux, certains d'ampleur internationale d'autres d'ampleur locale, dans les différentes régions du continent africain et européen. Le secrétariat de TSARA tient à la disposition des lecteurs la liste exhaustive des acronymes dont l'analyse (objectif, financement, partenariat, déroulé opérationnel, régions concernées, livrables) n'est pas faite ici.

ii) Présentation de projets

Co présidentes :

Genevieve Dione, ISRA, Sénégal

& Nadine Andrieu, Cirad, France





Les projets, menés dans le cadre de TSARA/ou en prise avec TSARA, sont détaillés en section II. (résumés et diaporamas).

Les intitulés, auteurs, institutions et périmètres sont les suivants.

Session parallèle A : Démarches de transition agroécologique - Geneviève Dione

Vers une transition des systèmes alimentaires grâce à un réseau régional de recherche multi-acteurs pour l'agroécologie en Afrique de l'Est (RMRN-EA)	Frank	CHIDAWANYIKA	*icipe*	Kenya et al
Agroécologie et agriculture durable en Afrique	Cédric	GAUCHEREL	INRAE	Burkina Faso
Le séminaire SIMPA : un dialogue Sud-Nord sur les approches participatives dans les zones humides	Calypso	BEAUCHAMP	INRAE	Maroc, Ouganda, Tunisie
Étudier la durabilité du maraîchage comme un problème de viabilité garantie	Isabelle	ALVAREZ	INRAE	Sénégal
Gouvernance de la transition agro-écologique au Burkina Faso: un état des lieux critique des politiques publiques de la transition agro-écologique dans la filière lait à Bobo-Dioulasso	Der	DABIRE	CIRDES	Burkina Faso
Pratiques d'atténuation pour un élevage à faible émission de carbone en Afrique subsaharienne : une approche de laboratoire vivant	Tobi	AKINROPO	INRAE	Nigéria & al
Montage d'un réseau euro-africain sur la réutilisation des eaux usées traitées	Jérôme	HARMAND	INRAE	Tunisie Maroc

Session parallèle B : Pratiques agroécologiques - Nadine Andrieu

Rétroactions éco-climatiques de l'initiative Green Legacy en Éthiopie : une analyse approfondie des forêts de caféiers à Maji, dans le sud-ouest de l'Éthiopie.	Ambaye	KEBEBA	AAU	Ethiopie
L'apiculture au service du maraîchage et de la biodiversité en Côte d'Ivoire	KoyoNzala&Kamila	REMICHE IVALDA & CANALE TABET	INRAE	Côte d'Ivoire
Gestion agroécologique de la reproduction ovine en Tunisie : Suivi automatisé de l'activité sexuelle de la race Noire de Thibar à l'aide du détecteur électronique de chevauchement Ovimate.	Samia	KHNISSI	INRAT	Tunisie
Les programmes de sélection communautaires, un cadre de gestion de la biodiversité génétique animale native tropicale : apprentissages croisés entre Sénégal et Guadeloupe	Younouss	CAMARA	UGB	Sénégal
Impact des changements dans les régimes pluviométriques sur les systèmes agroécologiques en Afrique subsaharienne : le cas de la production de maïs et de l'utilisation d'azote dans le Zimbabwe subhumide	Gwenaëlle	LASHERMES	INRAE	Zimbabwe
FrEgARCHAEO (réseau franco-égyptien d'archéologie et de génomique)	Jérome	SALSE	INRAE	Egypte
Bioressources locales pour la production durable de biopesticides microbiens : vers une alternative écologique et économique aux milieux de culture conventionnels	André	GADJI	CNRA	Côte d'Ivoire
Évaluation de la vulnérabilité des petits exploitants agricoles aux événements climatiques extrêmes dans les zones agroécologiques de la région de Sidama, en Éthiopie	Yoseph	YISEHAKE	Hawassa University	Ethiopie
Indicateurs Biologiques et Transition Agroécologique : Réponse des Microarthropodes dans Deux Living Labs Marocains	Outmane	EL OMRY	ENA Meknès USMBA	Maroc

Posters

Potentiel économique de la transition agroécologique	Afaf	SARI	ENA Meknès	Maroc
Faire tenir une ferme dans l'incertitude : une enquête mathématique au bord du lac de Guiers	Dame	THIAW	CIRAD	Sénégal
Présentation d'EPITAG « EPIdemiological modelling and control for Tropical AGriculture », une équipe associée franco-camerounaise	Suzanne	TOUZEAU	INRAE	Cameroun
Prévision de la résistance aux insecticides à l'aide de l'IA	Kiwoong	NAM	INRAE	?

Interactions arbres compagnons-cacaoyers et dynamique du statut acido-basique des sols en systèmes agroforestiers cacaoyers en Côte d'Ivoire	Emile B.	BOLOU BI	INPHB	Côte d'Ivoire

iii) Synthèse des présentations et perspectives

Session parallèle A : Démarches de transition agroécologique - Geneviève Dione

La session parallèle A consacrée aux démarches de transition agroécologique a réuni sept présentations, portées par des chercheuses et chercheurs, praticiennes et praticiens travaillant dans différents contextes africains et euro-africains. Les présentations ont été organisées en deux séquences successives, combinant des communications de 10 minutes et de 5 minutes, chacune suivie d'un temps collectif de questions-réponses.

Les travaux présentés ont abordé la transition agroécologique non pas comme un ensemble homogène de pratiques à diffuser, mais comme un processus complexe, situé et multi-acteurs, mobilisant des dispositifs variés de recherche, d'accompagnement et de gouvernance territoriale.

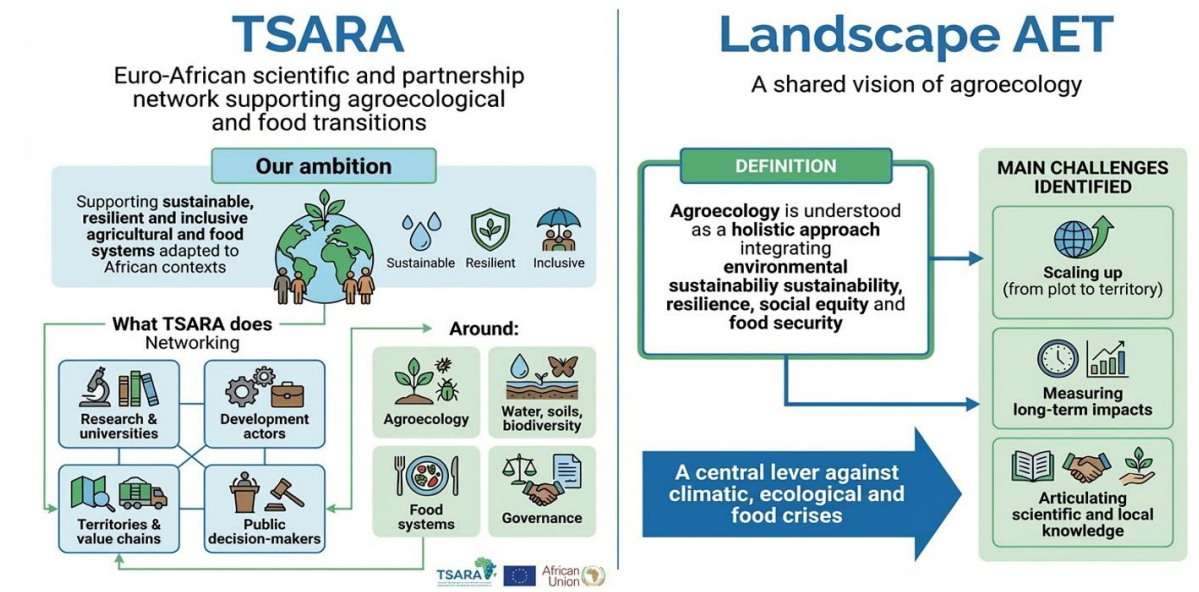
Un premier ensemble de contributions a porté sur le rôle des réseaux, des dispositifs de formation et de circulation des savoirs dans la structuration de la transition. Les projets présentés, notamment autour des réseaux régionaux d'agroécologie, des living labs multi-acteurs et des dispositifs de dialogue scientifique, montrent que la transition progresse moins par transfert technologique que par la construction d'écosystèmes de connaissances associant recherche, formation, acteurs de terrain et institutions publiques. Ces démarches soulignent le rôle spécifique de la recherche comme instance structurante et capacitante, tout en posant de manière récurrente la question de la pérennité des dynamiques au-delà des cadres projets.

Un second ensemble de présentations a abordé la transition agroécologique à partir des enjeux de gouvernance des ressources et des territoires, en particulier autour de l'eau, des filières agricoles et des infrastructures productives. Les travaux menés sur le maraîchage dans les Niayes, la filière lait au Burkina Faso ou encore la gestion de l'eau montrent que les principaux verrous à la transition sont rarement d'ordre technique. Ils sont liés aux règles d'accès aux ressources, aux cadres institutionnels existants, aux arbitrages collectifs et aux rapports de pouvoir. Dans ces contextes, la recherche joue un rôle de médiation, de diagnostic socio-institutionnel et de mise en discussion des règles, contribuant à rendre visibles les marges de transformation possibles. Ces projets rappellent que sans dispositifs de gouvernance adaptés, la transition agroécologique demeure fragile, voire réversible.

Un troisième ensemble de contributions a porté sur l'exploration des trajectoires possibles de transition, notamment à travers des approches de modélisation des systèmes socio-écologiques, agricoles et pastoraux. Ces travaux ne visent ni à prédire l'avenir ni à prescrire des solutions, mais à éclairer les choix collectifs en rendant visibles les compromis, les bifurcations possibles et les limites structurelles de certains scénarios. Ils soulignent toutefois un enjeu central : celui de la traduction de ces outils analytiques dans des arènes de décision réelles, sans réduction de la complexité sociale et écologique qu'ils mettent en évidence.

Pris dans leur ensemble, les projets présentés montrent que la transition agroécologique se construit à l'interface de la recherche, de l'action et de la gouvernance, avec des rôles différenciés pour la science : structurer des collectifs, accompagner des processus, outiller les acteurs, éclairer les choix et mettre en débat. Ils mettent également en évidence que la recherche ne peut se substituer aux choix

politiques ni aux compromis territoriaux, mais qu'elle peut contribuer à ouvrir des possibles et à éclairer les trajectoires de transformation.



Perspectives pour TSARA

- Renforcer l'articulation entre réseaux de recherche, dispositifs de formation et institutions publiques afin de sécuriser la pérennité des démarches de transition.
- Reconnaître pleinement la transition agroécologique comme un objet de gouvernance territoriale et non uniquement comme un ensemble de pratiques agricoles.
- Développer des interfaces plus étroites entre démarches participatives et outils de modélisation pour mieux accompagner les processus décisionnels.
- Poursuivre et amplifier les espaces d'échange scientifique et inter-acteurs, tels que les Science Days de TSARA, pour consolider une communauté de pratiques autour des transitions agroécologiques.

Session parallèle B : Pratiques agroécologiques - Nadine Andrieu, avec Benoît Dedieu, INRAE

Messages clés

Une diversité de pratiques agroécologiques explorées au sein de la communauté TSARA :

- diversité génétique (animale et végétale)
- biodiversité (insectes pollinisateurs)
- agroforesterie
- valorisation des résidus de culture
- biocontrôle
- diversification des activités productives.

Si on se réfère aux **13 principes de l'agroécologie** définis dans le rapport HLPE[4], on constate que chacune des études mobilise **un à trois de ces principes**. Les principes les plus souvent mobilisés dans les travaux :

- réduction des pesticides
- mobilisation de la biodiversité
- diversification
- recyclage
- santé du sol et des animaux.

Le changement et la variabilité climatiques sont explorés dans une majorité des études présentées.

Perspectives pour TSARA :

- mieux expliciter **les principes** de l'agroécologie explorés dans les travaux
- tenter dans chaque étude d'adresser un nombre plus important de principes agroécologiques
- articuler dans ces travaux les **principes biophysiques** avec les **principes socio-économiques**.

[4] Rapport n°14 du HLPE - High Level Panel of Experts, panel d'experts de haut niveau sur la sécurité alimentaire et la nutrition du Comité de la sécurité alimentaire mondiale - publié en 2019 sur les « Approches agroécologiques et autres approches novatrices pour une agriculture et des systèmes alimentaires durables propres à améliorer la sécurité alimentaire et la nutrition ».

2.2. SESSION 2 : SYSTÈMES ALIMENTAIRES DURABLES

Président :
Mohamed Taher Sraïri, IAV, Maroc



La session 2 a approfondi les enjeux opérationnels et systémiques des systèmes alimentaires durables. Les résultats montrent que les principaux problèmes à résoudre concernent les inégalités d'accès à l'alimentation, le manque de cohérence des politiques publiques, la dépendance aux importations et la qualité nutritionnelle des régimes alimentaires. Les priorités identifiées portent sur le renforcement de la résilience des systèmes alimentaires, la réduction des impacts environnementaux, l'amélioration de la nutrition et le développement des circuits courts reliant producteurs et consommateurs.

i) Établissement participatif du « paysage »

Animation :
Wiam Moumen, IAV, Maroc
& Zeine Zein Taleb, ENAM, Maroc





Selon les questions, entre 89 et 95 personnes ont répondu au sondage en ligne, dont 52% sont des femmes et 49% des hommes. La majorité des personnes est relativement jeune puisque 40% d'entre elles ont moins de 39 ans. Les questions et réponses données sont présentées ci-après.

- En trois mots, quels sont les termes qui vous viennent à l'esprit lorsque vous entendez l'expression « système alimentaire durable » ?

222 mots, présentés sous forme de nuage par l'application Wooclap (les couleurs sont établies dans un but de lisibilité, mais ne correspondent pas au sens des mots).



Résilience est au centre, donc le terme le plus cité, mais « Sécurité alimentaire » « sécurité »/ « Food security » seraient certainement au centre s'il y avait une seule langue. De même, environnement apparaît en gros et proche du centre, en français et en anglais (« environment »). « Health » et « Healthy » apparaissent plus fortement que « santé », reflétant peut-être le fait que les anglophones du groupe sont plus sensibles à cet aspect que les francophones.

Des mots moins fréquents comme « nourrissant », « cuisine », « aliments », « diversité », « *diet* (régime alimentaire) », « environnement alimentaire », « qualité », « sécurité sanitaire », « alimentation saine », peuvent être rattachés au grand groupe « nutrition/santé » ; « accessibilité » à « la sécurité alimentaire » ; « *Resource bondaries* » à Environnement, …

Ainsi, de façon centrale et sans pouvoir réellement les hiérarchiser on a :

Sécurité alimentaire, Résilience, Environnement, et Nutrition/Santé.

Autour de ces mots, d'autres notions apparaissent que l'on peut regrouper par exemple ainsi (en traduisant l'anglais vers le français) :

- « Agroécologie », « agriculture », « semences et races locales », « disponibilité alimentaire », « matière première durable »
- « Territoire(s) », « local », « souveraineté », « autonomie alimentaire »
- « Circularité », « recyclage », « moins de déchets »
- « Industrie alimentaire », « transformation », « traçabilité », « Répartition de la valeur le long de la chaine de valeur » , « chaîne de valeur »
- « Ethique », « respect », « génération future », « inclusivité », « équité », « socialement juste », « justice sociale », « droit à l'alimentation », « équitable », « humain au centre »
- « Choix », « gouvernance »
- Changement climatique (cité une fois) est un peu à part.

Ainsi, apparaissent de façon moins centrale, des mots liés à la production, à la transformation, à la gestion des déchets, et aussi aux lieux de ces actes (territoire), et aux décisions (choix, gouvernance) et valeurs associées (équité).

- Selon vous, quel objectif devrait être prioritaire dans la mise en place des systèmes alimentaires durables ? 89 répondants, plusieurs choix possibles parmi une liste.

Objectif(s) prioritaire(s)	Nombre de réponses	% des répondants
Renforcer la résilience des systèmes alimentaires	44	49%
Assurer la sécurité alimentaire	37	42%
Minimiser les impacts environnementaux	34	38%
Réduire les inégalités sociales	30	34%
Garantir l'accessibilité économique	26	29%
Améliorer la qualité nutritionnelle des aliments	25	28%
Renforcer le lien producteur-consommateur et développer les circuits courts	21	24%

Assurer la sécurité alimentaire, si on considère que l'accessibilité économique en constitut le pilier central, apparaît comme le premier objectif prioritaire des systèmes alimentaires durables, suivi du renforcement de la résilience, et de la minimisation des impacts environnementaux.

- Selon vous, quel est aujourd'hui le principal problème à résoudre pour réussir la transition vers des systèmes alimentaires durables ? 95 répondants, plusieurs choix possibles.

Problème identifié	Nombre de citations	Fréquence (% des répondants)
Mauvaise répartition et inégalités d'accès à l'alimentation	50	53 %

Manque de cohérence et de coordination des politiques publiques	47	49 %
Dépendance excessive aux importations	32	34 %
Impacts environnementaux trop élevés	23	24 %
Qualité nutritionnelle insuffisante	18	19 %
Production alimentaire insuffisante	12	13 %

« La mauvaise répartition et les inégalités d'accès » ont été citées par plus de la moitié des personnes (53%). « Le manque de cohérence et de coordination des politiques publiques » a également été fortement cité (49%). Il est intéressant de noter que l'insuffisance de la production alimentaire est le choix avec la plus faible fréquence puisque seulement 13% des répondants l'ont cité.

- Dans votre contexte, quel est le levier le plus urgent à activer pour transformer le système alimentaire ? 91 répondants, plusieurs choix possibles.

Levier d'action	Nombre de citations	Fréquence (%)
Relocaliser et structurer les filières alimentaires (souveraineté alimentaire, territorialisation)	56	62 %
Réorienter les politiques publiques et les aides agricoles	33	36 %
Faire évoluer les régimes et les comportements alimentaires	29	32 %
Lutter contre les pertes et le gaspillage alimentaires	28	31 %
Renforcer la régulation des acteurs privés et limiter l'influence des lobbies	24	26 %

Le levier relatif à la « souveraineté alimentaire, à la territorialisation, à la relocalisation et à la structuration des filières alimentaires », a été cité très majoritairement par 62% des répondants. Le levier concernant « la réorientation des politiques publiques et aides agricoles » arrive en seconde position, celui visant à « Renforcer la régulation des acteurs privés et limiter l'influence des lobbies » arrive en dernière position.

- Selon vous, quels sont aujourd'hui les principaux manques ou besoins en matière de formation sur les systèmes alimentaires durables ?

120 réponses, les propositions sont regroupées par grandes thématiques. Le rapport ne fournit pas de décompte exhaustif par thème ou région permettant un classement quantitatif fiable.

Thématique	**Principaux besoins exprimés**
Formation des agriculteurs et des professionnels	Formation du monde agricole, formation des acteurs, accompagnement des professionnels et renforcement des compétences techniques
Agroécologie et pratiques agricoles durables	Formation à l'agroécologie, promotion de la diversité des pratiques agricoles, gestion de la fertilité des sols, restauration des terres
Éducation et sensibilisation des consommateurs	Éducation nutritionnelle, sensibilisation aux régimes alimentaires sains, consommation de produits locaux, réduction des aliments ultra-transformés

Formation des décideurs et politiques publiques	Formation des décideurs, amélioration de la compréhension des politiques publiques, cohérence des politiques agricoles et alimentaires
Approche systémique et pluridisciplinaire	Formation transversale, approche holistique des systèmes alimentaires, liens entre agriculture, nutrition, environnement, économie et gouvernance
Gouvernance et participation des acteurs	Approches participatives, implication des parties prenantes, coordination entre acteurs et intégration des citoyens dans la décision
Recherche, données et transfert des connaissances	Diffusion des connaissances scientifiques, outils de diagnostic, données sur les systèmes alimentaires, valorisation des résultats de recherche
Filières et chaînes de valeur	Connaissance des débouchés, amélioration des circuits locaux, transformation des produits agricoles, transparence et meilleure répartition de la valeur
Environnement et gestion des ressources	Gestion des déchets et du gaspillage, réduction de l'impact environnemental des aliments, gestion des ressources naturelles

Cinq grandes priorités se dégagent de la lecture des contributions.

1. Renforcer les compétences de l'ensemble des acteurs :

Le besoin le plus récurrent concerne la formation des agriculteurs, des professionnels des filières, des décideurs publics et des autres parties prenantes. Les réponses soulignent aussi la nécessité de disposer de formateurs compétents, de structures de formation adaptées et de financements suffisants.

2. Passer d'une approche sectorielle à une approche systémique

Plusieurs contributions appellent à décloisonner l'agriculture, la nutrition, l'environnement, la transformation, la commercialisation et les politiques publiques. La formation devrait permettre de comprendre les interactions entre ces dimensions et les effets des décisions prises à différents niveaux.

3. Développer les compétences techniques en agroécologie et en production durable

Les réponses citent la formation à l'agroécologie, la diversité des pratiques agricoles, la fertilité et la restauration des sols, la gestion intégrée des ressources naturelles, les ravageurs et les diagnostics phytopathologiques. Elles abordent aussi la transformation locale et l'innovation agricole.

4. Mieux articuler alimentation, nutrition et environnement

L'éducation nutritionnelle, les régimes alimentaires sains fondés sur des produits locaux, la sensibilisation des consommateurs, les impacts environnementaux de l'alimentation et la réduction des pertes et du gaspillage reviennent dans plusieurs régions.

5. Relier les connaissances à l'action publique et aux dynamiques territoriales

Les participants demandent une meilleure intégration de la recherche dans la décision, des politiques publiques plus cohérentes, une gouvernance territoriale renforcée et une participation accrue des citoyens et des acteurs concernés.

- Quels projets, initiatives, programmes ou réseaux liés aux systèmes alimentaires durables connaissez-vous aux niveaux national, régional ou international ?

87 réponses sont données, regroupées selon les régions indiquées par les répondants. Il s'agit d'un inventaire et non d'un classement par fréquence de citation.

Région	Projets, initiatives, programmes et réseaux cités
Europe	FutureFoodS Partnership ; DEPHY ; Agralife ; Osaé ; DIVINFOOD ; FAO ; Terralim ; PAT France ; PAFaO ; Chaire UNESCO Alimentations du monde ; Communauté de savoirs « Systèmes alimentaires durables » (SyaD) ; SADUR
Afrique du Nord	Projet de transformation des systèmes alimentaires porté par la Banque mondiale et le MAPMDREF ; fermes urbaines ; Terre Verte Maroc ; MASSIRE
Afrique de l'Ouest	GeCROC ; UP-RISE ; Food-EPI ; DUNDI FERLO ; FSRP ; FERLOSINE FAIRCARBON ; Or4food ; DYTAES ; SAFEVEG ; SAFOODS ; REPER ; Fair Sahel ; ProPulse ; MAHDIA ; MARIGO
Afrique centrale	Scaling Up Nutrition ; FCI4Africa ; AFSF ; initiatives du PAM et de VLIR-UOS en RDC sur l'agriculture intelligente face au changement climatique ; CORAF ; FAO ; FEM ; Biofin
Afrique de l'Est	FSRP ; DESIRA ; GRET ; FAO ; AGRA ; RUFORUM ; ARUA ; InnoFoodAfrica ; AFRETEC ; initiatives nationales de transformation des systèmes alimentaires à Madagascar
Afrique australe	CoE-FS ; HARNESSFARMS au Malawi ; FAMA
Autres initiatives internationales	CSA-FAO ; Food Systems Sustainability Transitions Institute (Uruguay) ; Soil Star ; World Microbiome Partnership ; AfriFOODlinks ; SystemAgrOH

Synthèse générale des résultats

Les réponses mettent en évidence plusieurs priorités transversales :

- La sécurité alimentaire, la résilience, la nutrition et la santé, l'environnement constituent des objectifs majeurs de la transition vers des systèmes alimentaires durables.
- Les inégalités d'accès à l'alimentation et le manque de coordination des politiques publiques sont les deux problèmes les plus fréquemment cités.
- La relocalisation et la structuration des filières alimentaires constituent le levier d'action le plus cité.
- La formation des agriculteurs, l'éducation nutritionnelle et l'approche systémique ressortent comme des besoins importants dans les réponses ouvertes sur les besoins en formation.
- La diversité des projets et réseaux mentionnés témoigne de l'existence d'initiatives dans différentes régions.

Ces résultats soulignent l'intérêt pour les participants d'articuler les politiques publiques, la formation, la recherche et le développement des filières territoriales pour accompagner la transition vers des systèmes alimentaires durables.

ii) Présentation de projets

Co présidentes :

Arlène Alpha, Cirad & Emmanuelle Maguin, INRAE, France

& Catherine Kunyanga, U. of Nairobi, Kenya





Les projets, menés dans le cadre de TSARA/ou en prise avec TSARA, sont détaillés en section II. (résumés et diaporamas).

Les intitulés, auteurs, institutions et périmètres sont les suivants.

Session parallèle A : Durabilité des systèmes alimentaires, sécurité alimentaire et nutritionnelle, sécurité sanitaire - Arlène Alpha & Emmanuelle Maguin

Une alimentation plus saine est-elle culturellement abordable en Afrique ? Données provenant de quatre pays africains	Joaquin	AMELLER	Cirad	Ethiopie, Kenya, Afrique du Sud, and Ouganda
Hétérogénéité des préférences et de la volonté des agriculteurs de payer pour des variétés d'ensete améliorées et résistantes au climat en Éthiopie	Tesfaye Etensa	GUTA	AAU	Ethiopie
Migration temporaire et consommation alimentaire des ménages au Nigeria	Elodie	MAITRE D'HOTEL	Cirad	Nigéria
Aperçu des aliments africains et de leurs effets sur les maladies inflammatoires de l'intestin	Moez	RHIMI	INRAE	Namibie
Enquêtes sur les pratiques liées à l'allaitement maternel dans le Sud-Est de la République démocratique du Congo	Francisca	NGENDA KABOMBO	U. Nantes	Congo
Influence des relations de pouvoir au sein des ménages sur la diversité alimentaire et l'accès à la nourriture; accès pour les femmes enceintes, les mères allaitantes et les enfants de moins de cinq ans dans la sous-ville d'Akaki Kality, à Addis-Abeba	Tadese Elleni	TAMIRE	AAU	Ethiopie
Caractérisation génétique et phylogéographique des virus de la grippe aviaire H9N2 circulant au Mali et dynamique de dispersion à travers l'Afrique de l'Ouest.	Idrissa Nonmon	SANOGO	U. Ségou	Mali
Valorisation des ressources microbiennes du Maroc vers des applications en nutrition et santé humaine au travers d'une collaboration durable entre l'Institut MICALIS INRAE (France) et le CNRST de Rabat (Maroc)	Christel	MAILLET	INRAE	Maroc
Transformation agricole et sécurité alimentaire en Afrique : défis, enseignements et perspectives d'avenir.	Bekele Wegi	FEYISA	AAU	Ethiopie

Session parallèle B : Transformation agro-alimentaire et/ou nexus eau-énergie-alimentation – Catherine Kunyanga

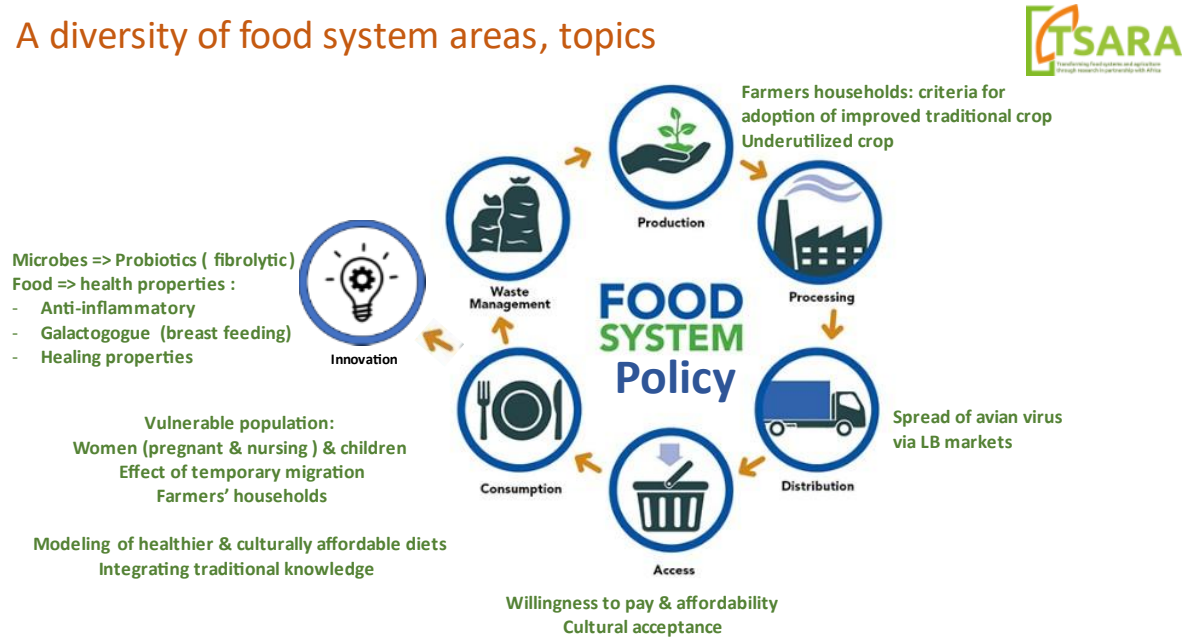
Facteurs de performance dans les PME de transformation de noix de cajou en Afrique de l'Ouest : analyse intégrée des facteurs techniques et organisationnels.	Mamadou Tanou	DIALLO	UGB	Sénégal, Burkina
Impact des variétés d'arachides sur la qualité nutritionnelle	Doriane Delacroix	OUEDRAOGO	AgroParisTech	Senegal, Mali, Ghana, Niger, Malawi, Zambia, Togo, Mozambique, Uganda
Diversité des légumineuses camerounaises et procédés sobres pour la fabrication de farines infantiles	Adeline	BOIRE	INRAE	Cameroun
Valorisation durable des insectes comestibles au Cameroun : qualité nutritionnelle, optimisation des procédés et stabilité des farines des Rhynchophorus phoenicis, Imbrasia truncata et Imbrasia epimethea	Aymar Rodrigue	FOGANG MBA	Univ Douala	Cameroun
Analyse sociotechnique du secteur de la mangue au Sénégal : aperçu du projet Africold.	Fatou-Toutie	NDOYE	INRAE	Sénégal Tanzanie
Dynamique et contraintes de la production de chameaux au Maroc	Fadwa	GUIMIMI	IAV Hassan II	Maroc
SenBICPha - Cartographie et caractérisation qualitative des produits halieutiques conservés par fermentation artisanale au Sénégal dans une perspective d'optimisation des procédés	Marie-France	PILET	INRAE	Sénégal
Évaluation de la phytotoxicité des eaux usées laitières à l'aide de la laitue (Lactuca sativa L.) et de la lentille d'eau (Lemna minor) comme bioindicateurs	Oulaya	ZOUI	ENA Meknès	Maroc
Commerce international et gestion de l'eau en agriculture : Le cas de la Tunisie	Sarra	KEKLI	INRAE	Tunisie

Posters

Valorisation des déchets de filets de sardines (Sardina pilchardus) et des sous-produits générés lors de la mise en conserve pour la production de farine et d'huile nutritionnelles destinées à enrichir les aliments	Hind	MKADEM	IAV Hassan II	Maroc
Les rencontres internationales « Lait Vecteur de Développement » : genèse et objectifs	Said	BOUHALLAB	INRAE	Continent
Utilisation de l'information génomique pour caractériser l'adaptation et la vulnérabilité des races bovines locales européennes et d'Afrique subsaharienne au changement climatique.	Dominique	AHOUANHODE	INRAE	Côte d'Ivoire
Évaluation de l'activité des cafés à Addis-Abeba : tendances marketing post-COVID-19	Molla	Setargew MEKASHAW	AAU	Ethiopie
Apparition de la brûlure bactérienne du niébé au Burkina Faso - NIEBABU	Nanwinyele Euvaris	SOME	INERA	Burkina Faso

iii) Synthèse des présentations et perspectives

Session parallèle A : Durabilité des systèmes alimentaires, sécurité alimentaire et nutritionnelle, sécurité sanitaire - Arlène Alpha & Emmanuelle Maguin



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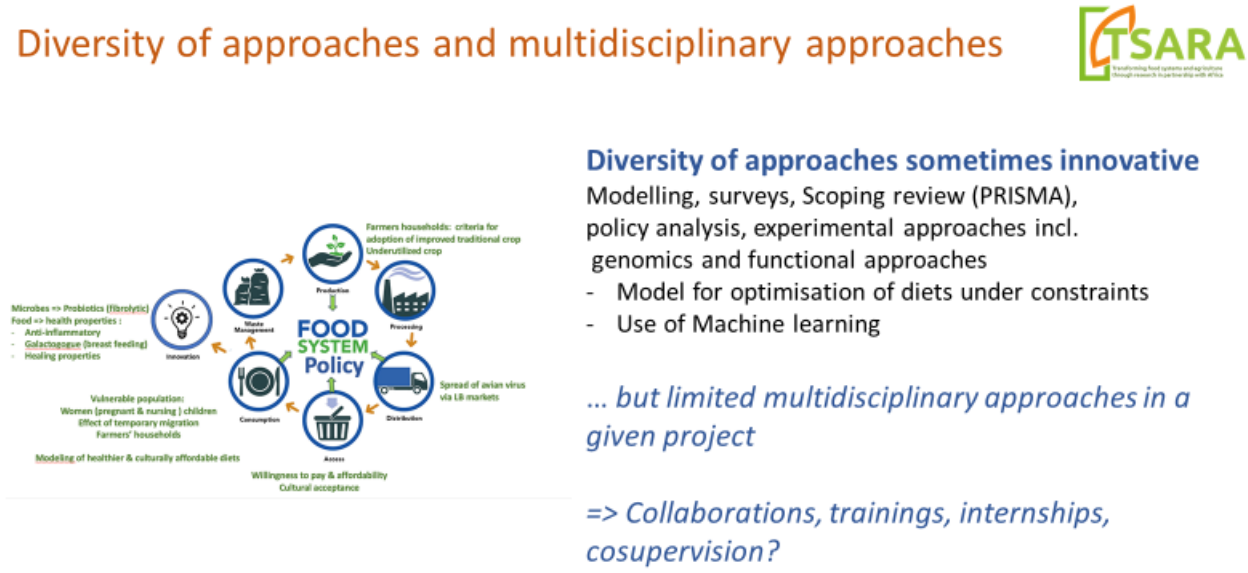


Approches multidimensionnelles :

Intégration des multiples dimensions de l'alimentation et des compromis entre ces dimensions :

- Acceptabilité culturelle d'une part, et accessibilité économique/pouvoir d'achat d'autre part
- Avantages à court terme contre avantages à long terme

    - par exemple, critères des agriculteurs pour l'adoption de variétés améliorées
- Équilibre entre les aspects positifs et négatifs
    - par exemple, augmentation de la consommation de fruits, de légumes et de lait dans les ménages comptant un membre revenu de l'émigration par rapport à l'augmentation de la consommation de graisses, de sucres et de produits transformés

Facteurs pouvant être remis en question en fonction des contextes locaux et culturels

- ex. : l'Éthiopie a signalé que la diversité alimentaire est moindre lorsque les femmes dominent les décisions relatives à la préparation des repas. Amélioration observée avec une plus grande parité dans les décisions liées à l'alimentation.

Recommandations en matière de politique alimentaire :

Prendre en compte le caractère déterminant de certains facteurs pouvant varier en fonction du contexte, des typologies de sous-populations (typologies d'agriculteurs, populations vulnérables) et de la géographie

- Importance des contraintes économiques sur le comportement des acteurs des systèmes alimentaires (producteurs, consommateurs)
- Habitudes alimentaires et approche de l'alimentation en lien avec l'acceptabilité culturelle, les changements induits par les dynamiques migratoires, la compréhension du fonctionnement du microbiote intestinal, la diversification pendant l'allaitement, les recettes traditionnelles et le régime méditerranéen
- Soutenir l'autonomisation des femmes non seulement au niveau des ménages, mais aussi aux niveaux communautaire et national

Points à retenir :

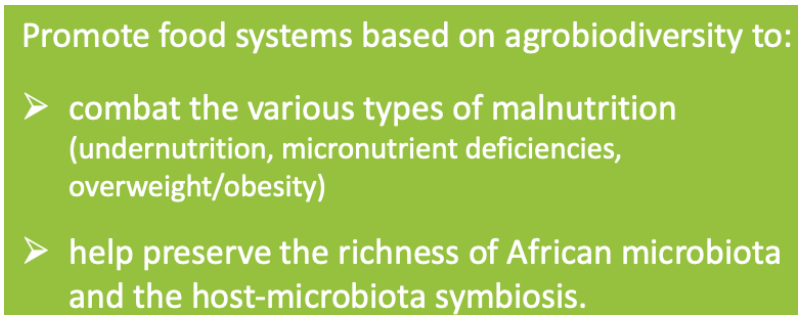
Une session très riche et intéressante, avec des travaux d'excellente qualité :

=> Souvent des publications, des présentations orales, de nouveaux projets

=> La majorité des projets/collaborations ont permis de développer la formation, la mobilité des jeunes chercheurs et la co-direction de thèses.

PERSPECTIVES

- Renforcer les approches multidisciplinaires dans les projets (via des réunions TFT ?)
- Mieux intégrer les défis et les enjeux environnementaux
- L'importance et la nécessité des échanges de connaissances et de la mobilité des personnes ont été soulignées => à développer ?
- TFT « Transformations des systèmes alimentaires et nutrition pour la santé », avec deux priorités, abordées par des projets.



La mise à jour de la stratégie et des axes de travail avec de nouveaux partenaires constituera un atout.

Session parallèle B : Transformation agro-alimentaire et/ou nexus eau-énergie-alimentation – Catherine Kunyanga

La session a donné lieu à huit présentations très instructives, animées par divers chercheurs, principalement des doctorants spécialisés dans la transformation agroalimentaire. La première partie comprenait quatre présentations : deux de 10 minutes chacune et deux de 5 minutes, suivies d'une séance de questions-réponses de 10 minutes. La deuxième partie comprenait également quatre présentations : une de 10 minutes et trois de 5 minutes, conclues par une autre séance de questions-réponses de 10 minutes.

La transformation agroalimentaire joue un rôle crucial dans la sécurité alimentaire et nutritionnelle de nombreux pays. Les résultats présentés portaient principalement sur l'amélioration des chaînes de valeur liées à la transformation des noix de cajou, des arachides, des légumineuses et du poisson, y compris des approches innovantes concernant les insectes comestibles et la production de chameaux par les éleveurs des régions arides d'Afrique. Les recherches ont mis en avant des technologies, des innovations, des pratiques, des produits, des procédés, des stratégies et des politiques qui contribuent de manière significative à l'amélioration de la sécurité alimentaire et nutritionnelle dans divers pays.

Les intervenants ont présenté des études transdisciplinaires et multidisciplinaires, couvrant des thèmes tels que les techniques de sélection moléculaire visant à améliorer les caractéristiques des cultures, l'amélioration de la qualité nutritionnelle des aliments, l'optimisation de procédés tels que la fermentation, la déshydratation et la congélation, ainsi que le développement de produits destinés à des populations spécifiques, notamment les aliments pour nourrissons. En outre, ils ont abordé la gestion des technologies post-récolte, en particulier la logistique de la chaîne du froid, ainsi que la commercialisation de produits dérivés du chameau, tels que le lait de chameau pasteurisé et fermenté et le fromage de chameau dans les régions arides. Les présentations ont également porté sur la valorisation et le développement des marchés des produits alimentaires d'origine végétale, la gestion de l'eau, le commerce et les interconnexions entre l'alimentation, l'eau et l'énergie.

Ces résultats sont particulièrement intéressants car les systèmes alimentaires connaissent actuellement des transformations rapides qui ont un impact significatif sur les régimes alimentaires. Parmi les facteurs qui influencent cette évolution, on peut citer la mondialisation, l'expansion du commerce alimentaire, les innovations technologiques, l'allongement des chaînes d'approvisionnement et de transformation alimentaires, ainsi que la volatilité des prix des denrées alimentaires, tous ces éléments étant exacerbés par la récession mondiale consécutive à la pandémie de Covid-19.

Pour TSARA :

- Accroître sa visibilité afin d'attirer des acteurs socio-économiques multisectoriels et multidisciplinaires du Sud.
- Renforcer l'échange et le partage des connaissances grâce à la mobilité des étudiants et du personnel entre le Sud et le Nord, ainsi qu'entre les pays du Sud.
- Développer les partenariats et les collaborations à tous les niveaux.
- Organiser davantage de forums interactifs, à l'image des TSARA Science Days.

2.3. SESSION 3 : INTERACTIONS AGROÉCOLOGIE - SYSTÈMES ALIMENTAIRES DURABLES

Présidente :
Awa Diattara, Univ. Gaston Berger, Sénégal



La session 3 a mis l'accent sur les leviers de transformation et les dynamiques d'action, confirmant l'agroécologie comme un outil clé pour renforcer l'autonomie des territoires, relocaliser les filières et favoriser des politiques alimentaires plus cohérentes. Elle a également souligné l'importance des réseaux, projets et partenariats existants, ainsi que la nécessité de renforcer la formation, la gouvernance multi-acteurs et le dialogue science-politique.

i) Établissement participatif du « paysage »

Animation :
Khadija Jaafary
& Wiam Moumen, IAV, Maroc





Sur les 91 participants au sondage, 55 % sont des hommes et 45 % des femmes avec une médiane entre 40 et 54 ans. Les questions et réponses données sont les suivantes.

- **Dans quelle mesure l'agroécologie est-elle indispensable à la durabilité des systèmes alimentaires ?** Sur une échelle de 1 à 5, 49 % la considère comme très importante, 41% comme absolument indispensable. Les autres opinions (optionnelle, peu importante, moyennement importante) ne sont pas vraiment plébiscitées, pour partie parce que c'est l'agriculture durable (au-delà de l'agroécologie) qui est importante. Les justifications du caractère « très important » ou « absolument indispensable » (les questions étaient ouvertes aux commentaires) sont nombreuses : pour la survie de l'humanité, il faut rester dans les limites planétaires, et seule l'agroécologie assure les différentes dimensions de la durabilité, résilience et équité ainsi que souveraineté alimentaire. L'attention au maintien des ressources (qui sont finies), à la qualité des sols, à la stabilité des écosystèmes préserve l'environnement pour les générations à venir, améliore la qualité des produits et permet au final une production durable.

- Sur une échelle de 1 à 5, **dans quelle mesure l'agroécologie peut-elle nourrir la population mondiale** (en quantité et en qualité) ? Les réponses « 4 : largement » dominent (54 % des votants), mais les avis « 3 : modérément » (24 %) sont importants, plus que ceux qui envisagent que l'agroécologie permet de nourrir complètement la planète (18 %). Les avis négatifs représentent 7 % des votants.

- **En quoi l'agroécologie est-elle un levier de transformation des systèmes alimentaires ?** Les réponses les plus plébiscitées sont « améliorer la qualité et la diversité alimentaire » (64 % des votants) et réduire les impacts environnementaux (53 %). Viennent ensuite les réponses « améliorer l'autonomie

des producteurs et des territoires (38 %), « questionne l'organisation des filières et des politiques » (28 %) et « favorise les circuits courts » (21 %).

- Dans votre contexte **quel est le levier le plus urgent à activer pour transformer le système alimentaire ?** La réponse la plus plébiscitée est « réorienter les politiques publiques et les aides agricoles » (67 % des votants), puis « relocaliser et structurer les filières alimentaires (souveraineté alimentaire, territorialisation) » (46 %). Viennent ensuite à égalité « faire évoluer les régimes alimentaires » et « renforcer la régulation des acteurs privés et limiter l'influence des lobbies » (34 %). Lutter contre les pertes et gaspillages vient en dernier (26 %).

- **Les politiques agricoles et alimentaires de votre pays sont-elles, selon vous, cohérentes avec les principes de l'agroécologie ?** Sans surprise, c'est la réponse « peu cohérentes » qui est plébiscitée (34 % des votants) devant « pas du tout cohérentes » (21 %) et « plutôt cohérentes » (16 %). Personne ne trouve que les politiques agricoles et alimentaires sont cohérentes avec l'agroécologie !

- **Quels axes / leviers prioritaires sont clés pour articuler agroécologie et systèmes alimentaires durables ?** 74 % des répondants plébiscitent la réponse « circuits courts/ projets alimentaires territoriaux/ produits locaux », considérant que ce sont actuellement les leviers les plus dynamiques avec une valorisation des produits et une bonne rémunération des producteurs locaux. Vient ensuite l'agriculture biologique (31 %), à la fois agroécologique et déjà organisée comme une filière. Viennent ensuite la réduction des pertes et gaspillages (17 %) et les régimes alimentaires plus végétaux (11 %). Une rubrique « autre » avait été proposée. Plusieurs idées ont été exprimées : mieux reconnecter les attentes des consommateurs et les pratiques des agriculteurs ; limiter le poids des lobbies sur les décisions politiques ; mais aussi repositionner l'agroécologie dans le cadre d'une agriculture durable et adaptée au changement climatique.

- Une question concernait **les projets, programmes et réseaux en lien avec l'articulation agroécologie et systèmes alimentaires**. Comme précédemment la liste des réseaux et projets cités n'est pas reprise ici : ils sont très nombreux, certains d'ampleur internationale d'autres d'ampleur locale, dans les différentes régions du continent africain et européen. Le secrétariat de TSARA tient à la disposition des lecteurs la liste exhaustive des acronymes dont l'analyse (objectif, financement, partenariat, déroulé opérationnel, régions concernées, livrables) n'est pas faite ici.

ii) Présentation de projets

Co présidents :

Zoubir Chattou, ENA Meknes, Maroc

& Tobi Akinropo, Obafemi Awolowo University/INRAE, Nigéria/France





Les projets, menés dans le cadre de TSARA/ou en prise avec TSARA, sont détaillés en section II. (résumés et diaporamas).

Les intitulés, auteurs, institutions et périmètres sont les suivants.

Session parallèle A : Territoire (local, politique, …) - Zoubir Chattou

Dynamique, facteurs et impacts des changements d'utilisation et de couverture des sols dans les hautes terres d'Afrique de l'Est : revue systématique et méta-analyse à partir de données provenant d'Éthiopie	Getachew Woldemedhin	DAGNE	Salale U., College of Agriculture and Natural Resource, Fitche	Ethiopie
Patrimoine agroécologique et transition territoriale : enseignements de la dynamique PRATAM en Basse-Casamance	Raphael	BELMIN	CIRAD	Sénégal
Conditions de création d'emplois dans les périmètres rizicoles engagés dans la transition agroécologique au Sénégal : cas de la vallée du fleuve Sénégal	Pape Bilal	DIAKHATE	ISRA	Sénégal
Comprendre le travail agricole au Burkina Faso : Analyse des contraintes et de la satisfaction liées au genre dans les rizières conventionnelles et écologiques	Eveline	COMPAORÉ SAWADOGO	INERA	Burkina Faso
Le dP ASAP (Agroécologie et Systèmes Agro-sylvo-Pastoraux) s'oriente vers la conception d'innovations et de systèmes de production agroécologiques répondant aux attentes des opérateurs des systèmes alimentaires et des consommateurs au Bénin, au Burkina Faso, en Côte d'Ivoire et au Mali.	Eric	VALL	CIRAD	Bénin, Côte d'Ivoire, Burkina, Mali
Soutenabilité des pratiques agro-sylvopastorales dans le Parc National d'Ifrane (Moyen Atlas, Maroc) dans un contexte de changement climatique.	Noé	DANIEL NGUYEN	Institut Agro Rennes-Angers	Maroc
Voies d'innovation agroécologique pour la transition des systèmes alimentaires dans les régions agro-pastorales reculées du Kunene, en Namibie.	Léon	BICKEL-PASCHE	Institut Agro Montpellier	Namibie
Pastoralisme, résilience et sécurité alimentaire : une modélisation viabiliste appliquée au Sénégal	Daouda	NDIAYE	CIRAD	Sénégal
Les marchés territoriaux des produits agroécologiques au Maroc entre le défi de l'offre des produits, l'absence d'un cadre institutionnel et les perceptions des consommateurs : Cas du Souk Al Fellah et du marché de la coopérative Bio Shoul de Rabat	Mohamed	EL AMRANi	ENA Meknès	Maroc

Session parallèle B : Approche (modélisation, surveillance, résilience) – Tobi Akinropo

Systèmes alimentaires durables en Éthiopie : faire le lien entre agroécologie, résilience et sécurité alimentaire.	Bekele	AKLILU	AAU	Ethiopie
Modélisation spatiale pour faire progresser la gestion durable des pâturages en Afrique.	Gianni	BELLOCCHI	INRAE	Afrique du Sud, Sénégal, Maroc
CAMPIGEN : diversité génétique des porcs indigènes du Cameroun et résilience agroécologique	Pierre	FAUX	INRAE	Cameroun
Faire le lien entre agroécologie et systèmes alimentaires : potentiel d'innovation fourragère multipartite dans le delta du fleuve Sénégal.	Serena	FERRARI	Cirad	Sénégal
Lutte biologique par phages contre l'épidémie émergente de brûlure bactérienne des feuilles à Madagascar	Clara	TORRESBARCELO	INRAE	Madagascar
Les radios locales peuvent-elles contribuer à la surveillance épidémiologique ?	Sarah	VALENTIN	Cirad	Cameroun
MORFeuS : Des solutions Nexus Eau-Energie-Alimentation-Écosystèmes pour des territoires méditerranéens résilients	Laure	HOSSARD	INRAE	Algérie, Maroc, Tunisie
Inactivation électrochimique des parasites nageant librement ; le chlore libre et le champ électrique comme agents de	Begumisa	GODFREY MAGYEZI	Mbambara University	Ouganda

désinfection puissants pour les cercaires de Schistosoma mansoni				
Résilience et stabilité fonctionnelle dans une prairie subhumide d'Afrique du Sud soumise à une décennie de variabilité climatique et de gestion	Lily	MUNZHEDZI	Univ. South Africa	Afrique du Sud, Sénégal, Maroc

Posters

Le Projet AWA (Agroecology in West Africa) - Des systèmes alimentaires agroécologiques pour une agriculture durable et une alimentation saine en Afrique de l'Ouest	Eric	VALL	Cirad	Sénégal, Bénin
Interactions entre le changement climatique et les systèmes alimentaires et stratégies d'adaptation des petits exploitants agricoles : données provenant du cours supérieur de l'Omo, dans le centre-sud de l'Éthiopie	Elias	SHIFERAW	AAU	Ethiopie
Organisation des chaînes de valeurs et transition agroécologique des systèmes alimentaires : une étude de cas exploratoire au Sénégal	Fatimatou Zahra	NDOYE	Institut Agro Montpellier	Sénégal
Bioactivation du biochar par digestion anaérobie : transformation physico-chimique et modification de la teneur en nutriments pour l'amendement des sols	Eniyew	ABEBAW	AAU	Ethiopie
Évaluation de la diversité du complexe d'espèces Ralstonia solanacearum au Ghana et sélection de porte-greffes de tomates résistants à la flétrissure bactérienne.	Matilda	FRIMPONG	INRAE - CSIR	Ghana

iii) Synthèse des présentations et perspectives

Session parallèle A : Territoire (local, politique, …) - Zoubir Chattou

Message clé :

L'agroécologie est un moteur essentiel du développement rural, favorisant des systèmes alimentaires durables et résilients grâce aux savoirs locaux, aux ressources et à l'action collective.

6 axes prioritaires :

- utilisation des terres et transition : des stratégies agroécologiques co-conçues et adaptées au contexte local ;
- patrimoine et savoirs : valorisation des pratiques locales et de l'innovation participative ;
- travail et inclusion : création d'emplois ruraux équitables et décents ;
- innovations : solutions techniques, sociales et organisationnelles au service de la résilience ;
- élevage et sécurité alimentaire : renforcement de systèmes pastoraux résilients ;
- marchés et consommation : mise en relation de la production, du territoire et des marchés locaux.

Objectif : intégrer l'agroécologie, l'inclusion sociale et les systèmes alimentaires durables grâce à une recherche orientée vers l'action et à un soutien aux politiques publiques.

Session parallèle B : Approche (modélisation, surveillance, résilience) – Tobi Akinropo

La session s'est concentrée sur les interactions entre la transition agroécologique et les systèmes alimentaires durables. Plusieurs approches complémentaires ont été abordées, notamment la modélisation, le suivi et la résilience dans différents systèmes de production. La session a présenté un ensemble diversifié et interdisciplinaire de projets et d'exposés, couvrant une vaste zone géographique. Dans leur ensemble, ces projets ont mis en évidence la manière dont les principes agroécologiques sont mis à profit pour parvenir à des systèmes alimentaires durables, notamment pour orienter les pratiques de production, les modes de consommation et la prise en compte des enjeux environnementaux au sein du système alimentaire.

Au total, neuf présentations (trois de 10 minutes et six de 5 minutes chacune) ont été faites. Ces présentations reconnaissent la nature transdisciplinaire d'une approche agroécologique qui englobe la science, un ensemble de pratiques et un mouvement social.

Une approche scientifique intégrant la recherche, la formation, l'action et le changement contribue à la durabilité de toutes les composantes du système alimentaire : les mouvements écologiques, économiques et sociaux. Quatre présentations ont utilisé des approches fondées sur la recherche. Le projet intitulé « Lutte biologique par les phages contre l'épidémie émergente de brûlure bactérienne des feuilles à Madagascar » a exploré l'utilisation des phages comme agents de lutte biologique, en alternative à l'utilisation croissante des pesticides. Des approches de modélisation ont été appliquées pour soutenir une prise de décision éclairée en matière de pratiques agricoles et de gestion fourragère, en vue de faire progresser la gestion durable des pâturages en Afrique. Des outils génétiques et des techniques moléculaires ont été utilisés dans le projet « Diversité génétique des porcs indigènes au Cameroun et résilience agroécologique », qui visait à évaluer les niveaux de métissage chez les races locales et à explorer leur potentiel pour soutenir des systèmes de production porcine résilients, contribuant ainsi à la conservation de la biodiversité. Enfin, une étude en cours sur les prairies dans la région pédoclimatique subhumide d'Afrique du Sud s'est concentrée sur la mise en place de prairies résilientes et fonctionnellement stables afin de soutenir les moyens de subsistance et d'orienter la gestion durable des terres.

En tant qu'ensemble de pratiques agricoles, trois projets cherchent des moyens d'améliorer les systèmes agricoles en exploitant les processus naturels, en créant des interactions biologiques bénéfiques et des synergies entre les composantes des agroécosystèmes, en réduisant au minimum les intrants externes synthétiques et toxiques, et en utilisant les processus écologiques et les services écosystémiques pour le développement et la mise en œuvre de pratiques agricoles, renforçant ainsi la durabilité du système alimentaire. Concernant les mouvements sociaux, un projet a mis en évidence l'utilisation de la collecte de données par radio, en mettant l'accent sur l'inclusion des communautés locales pour améliorer la surveillance épidémiologique. Par ailleurs, un projet s'est concentré sur le potentiel de transposition à plus grande échelle des innovations multipartites en matière de fourrage dans le delta du fleuve Sénégal, en identifiant des liens étroits avec les relations sociales, les valeurs, les croyances et les approches de transposition à grande échelle.

En conclusion, les interactions entre la transition agroécologique et les systèmes alimentaires durables sont significatives, car elles contribuent à une meilleure efficacité dans l'utilisation des ressources, au renforcement de la résilience des systèmes alimentaires, ainsi qu'à l'amélioration de l'équité et de la responsabilité dans les politiques et la gouvernance à l'échelle de l'ensemble du système alimentaire.

2.4. SESSION 4 : DISCUSSION ET MISE EN PERSPECTIVE

Président :
Norman Maïwashe, ARC, Afrique du Sud



Dans la continuité des présentations de projets menés dans les domaines de l'agroécologie et/ou des systèmes alimentaires durables, dans le cadre ou en prise avec TSARA, des différentes synthèses de ces présentations et des sessions dédiées, la session 4 visait à **dégager des orientations et des pistes en termes de recherches, actions et projets à mener et modalités d'action pour que TSARA ait un impact.**

Après un temps de synthèse des sessions par les président(e)s et coprésident(e)s (cf. § 2.1.iii), 2.2.iii), 2.3.iii)) puis de synthèse participative, **deux tables rondes ont permis de recueillir les recommandations** de témoins d'horizons différents et complémentaires (producteurs agricoles, interface science-politique, secteur privé et ONG, recherche).

i) Synthèse et mise en perspective participatives

Animation :
Wiam Moumen, IAV, Maroc
& Zeine Zein Taleb, ENAM, Maroc



L'objectif de cette séquence est de recueillir le retour des participants sur les trois sessions précédentes afin de **nourrir les prochains Science Days**. Les résultats suivants sont complétés des éléments de **DÉBRIEFING** et des retours au **QUESTIONNAIRE POST-SCIENCE DAYS**, en fin de document.

En séance, 93 des participants ont répondu au sondage. 25% d'entre eux avaient 4 moins de 40 ans, 25% plus de 55 ans, près de la moitié entre 40 et 55 ans, avec une proportion de femmes et d'hommes du même ordre, les femmes un peu plus nombreuses que les hommes.

Evaluation des trois premières sessions : **% d'avis positif** (note de 4 ou 5/5) – sur les aspects suivants :
- Apports concrets en **agroécologie** : 66%
- Apports sur les **systèmes alimentaires durables** : 51%
- Compréhension des interactions entre les deux : 40%
- **Clarté et qualité scientifique des interventions** : 58%
- **Fluidité et dynamisme** des interventions et des échanges : 58%
- **Déroulé** des sessions, articulations des différentes séquences : 58%
- **Fonctionnement technique** : 55%.

Les 3 mots-clés retenus des 3 sessions (mixant anglais et français) :



Les grands défis actuels liés à l'agroécologie et bien abordés lors de ces sessions (3 mots maximum demandés ; mixant anglais et français) :



Les leviers pour renforcer l'impact de la recherche (3 mots maximum demandés ; mixant anglais et français) :



Les souhaits pour les prochains Science Days, en termes de thèmes, format, public (3 mots maximum demandés ; mixant anglais et français) :

- Thèmes / Thématiques : adaptation au **changement climatique**, agriculture **numérique**, **emploi** agricole, préservation de la **biodiversité**, gestion de l'**eau/ReUSE**, ***One Health*** **pour la sécurité alimentaire**, évaluation des **politiques publiques** (en particulier en matière d'agroécologie) et implication des pouvoirs publics et décideurs politiques.
- Format / Organisation : **présentiel** plébiscité (et/ou hybride), sur la **durée** (3 jours), au bénéfice de plus d'**interactions** et d'**échange approfondi** ; présentation orale des posters, retour et **partage d'expérience** (succès et échecs), ateliers de travail sur des **projets**, **prix** à remettre aux meilleures présentations et posters.

▪ Audience / Public : **multi-acteurs** : chercheurs du public mais également du privé ; plus d'étudiants ; acteurs de terrain - agriculteurs, bénéficiaires des projets, organisations locales - ; décideurs publics - politiques, ministères-, bailleurs de fonds et financeurs potentiels.

ii) Table ronde 1 : avis et recommandations de personnalités d'horizons complémentaires pour que TSARA ait un impact

Animation :

Mady Cissé, professeur en technologie alimentaire et responsable de formation à l'Université Cheikh-Anta-Diop (UCAD), Sénégal



Panélistes :

Saïd Chatibi, directeur de l'Association Nationale Ovine et Caprine, Maroc



Debele Debela, coordinateur du cluster 4 Mécanisation accélérée, technologie numérique améliorée et innovation pour la Transformation des systèmes alimentaires et nutrition en Éthiopie (EFSTN), à l'Ethiopian Agricultural Transformation Institute (ATI), Ethiopie



Khadi Desprez, responsable du Pôle Afrique de la Fondation Avril, France



Sophie Nicklaus, directrice scientifique Alimentation et Santé d'INRAE, France



Grandes lignes :

Pour contribuer par la recherche et la formation à assurer l'accès de tous à une alimentation saine, créer de la valeur et des emplois, préserver les ressources :

- co-construire les **trajectoires** à l'échelle des **territoires** de façon **inclusive**,
- appréhender **les systèmes alimentaires et les chaînes de valeur** dans leur entier, relier amont agricole et aval de la consommation, valoriser les produits, allier territoires, producteurs et consommateurs,
- soutenir la **cohérence des politiques** et la mise en place de **dispositifs publics innovants**,
- développer **des technologies et des données numériques** au service de l'adaptation au changement climatique et la prévision des risques, la productivité, la création d'emplois, l'inclusion des jeunes et des femmes, la diversité alimentaire et la valeur nutritionnelle, l'aide à la décision,
- s'attacher notamment aux **protéines végétales,** aux **races locales**, à la préservation des espaces pastoraux,
- mettre en place des mécanismes de **suivi** des actions, de responsabilisation, et de **partage des risques**,
- identifier les **questions de recherche** sous-jacentes et les modalités d'**interface science-politique** à développer.

TSARA : des recherches collaboratives menées dans différents domaines thématiques dans un objectif commun de contribuer à transformer les systèmes alimentaires et l'agriculture pour assurer l'accès de tous à une alimentation saine, durable, équitable/une sécurité alimentaire et nutritionnelle, tout en préservant les ressources et en créant de la valeur et des emplois. Il s'agit de cocréer et partager de nouvelles connaissances, des cadres analytiques, des méthodes et des innovations transformatrices.

QUELS PRINCIPES, LEVIERS ET OUTILS MOBILISER POUR RÉPONDRE À CET OBJECTIF COMMUN ET CONCILIER DES ENJEUX PARFOIS OPPOSÉS, DANS LE CONTEXTE D'UN CHANGEMENT CLIMATIQUE EXACERBÉ, croissant, impactant cultures, élevages et ressources ?

PRINCIPES MIS EN AVANT :

- la fonction des systèmes alimentaires doit être de nourrir les populations, condition essentielle pour atteindre les objectifs de développement durable notamment l'ODD1 - Pas de pauvreté- et l'ODD 2 – Faim "Zéro" qui sont les piliers sur lesquels les autres peuvent se construire ;

- lier transition agroécologique et transition alimentaire n'est pas forcément évident : par exemple des projets concernant l'agroécologie ne permettent pas systématiquement de cerner la question de la transformation agroalimentaire et de l'accès au marché ; l'élevage doit à la fois répondre à une demande croissante de protéines animales et préserver l'environnement avec notamment des parcours de plus en plus dégradés sous l'effet du changement climatique et de la charge animale ; la nutrition doit être appréhendée dans ce lien comme une question prioritaire ;

- la préservation de l'environnement est une condition essentielle pour préserver la productivité des systèmes alimentaires sur le long terme ; l'épuisement ou l'altération des ressources est une réalité sous toutes les latitudes ;

- l'agriculture doit contribuer à soutenir le développement économique et assurer une bonne rémunération des producteurs tout en offrant des produits accessibles pour les consommateurs, et en s'attachant à une répartition de la valeur au long de la chaîne alimentaire équitable ;

- les réflexions sur l'organisation des systèmes alimentaires doivent intégrer l'ensemble de la chaîne de valeur : la transformation alimentaire a un double bénéfice, elle permet des gains de temps pour les utilisateurs finaux et de générer de la valeur économique ; l'organisation des débouchés des productions agricoles est donc aussi clé pour assurer ce développement économique ;

- il n'y a pas de compromis à trouver entre innovation, mécanisation et emploi, mais entre les emplois à faible productivité d'aujourd'hui et les emplois de haute qualité et résilients de demain ; l'innovation doit ouvrir de nouvelles perspectives d'emploi dans l'ensemble des systèmes alimentaires, transformer le travail, et non le remplacer, avec moins d'emplois manuels sur le terrain et plus d'emplois plus qualifiés, plus résilients et mieux rémunérés ; les gains de productivité constituent la condition préalable à un emploi durable - sans croissance de la productivité, la création d'emplois dans l'agriculture risque de contribuer à la pauvreté plutôt que de la réduire- ;

LEVIERS ET AXES TRAVAILLÉS/ À TRAVAILLER :

- appréhension des systèmes alimentaires dans leur entier avec i) une création d'emplois tout au long des chaînes de valeur, conformément au programme de développement des chaînes de valeur de Malabo ainsi qu'à ODD 9 - Industrie, innovation et infrastructure- et à l'ODD 12 - Consommation et production durables- ; au-delà de la production : transformation, optimisation nutritionnelle, valorisation des produits alimentaires, stockage, logistique ; ii) le développement de chaînes de valeur

et de marché fonctionnels qui relient les producteurs aux consommateurs et permettent à ces derniers d'accéder à une alimentation abordable et nutritive ;

- cohérence des politiques associée – alignement des politiques agricoles, sanitaires, commerciales, environnementales, industrielles et de protection sociale sur une vision commune des systèmes alimentaires -, leadership politique fort et dispositifs innovants ; par exemple en Éthiopie 16 ministères et des partenaires de développement sont mobilisés pour la transformation des systèmes alimentaires appréhendés dans leur ensemble, réunis dans un comité de pilotage interministériel dirigé par le vice-Premier ministre ; des initiatives d'accès au marché et de transformation par des coopératives féminines des aliments traditionnellement consommés en Éthiopie, comme les galettes de teff ou injera, sont mises en place par le gouvernement ; cette action publique sur la création des marchés a permis de relier l'amont agricole avec l'aval de la consommation et d'allier des territoires -circulation des flux importante entre territoires ruraux et territoires urbains consommateurs, de plus en plus denses- ;

- développement du capital humain et autonomisation des jeunes et des femmes (compétences, esprit d'entreprise et leadership) ;

- déploiement de technologies favorisant la productivité et adaptées au climat (mécanisation, semences améliorées, méthodes et installations d'irrigation économes en eau, technologies de gestion des sols) ;

- innovation agricole, technologies adaptées au climat, outils numériques, agriculture de précision, mécanisation délibérément conçus pour créer de nouveaux emplois ruraux en passant d'un travail manuel à faible productivité à des services de mécanisation, d'équipement, d'assemblage et de fabrication de pièces de rechange ; pour favoriser l'inclusion des jeunes et des femmes, augmenter les rendements et les revenus, améliorer la disponibilité et l'accessibilité financière des denrées alimentaires, et renforcer la diversité alimentaire et la valeur nutritionnelle ;

- déploiement des données numériques pour les services de conseil et l'aide à la décision (caractérisation des changements, alerte précoce et gestion des risques climatiques, demande et prévisions en matière d'intrants, informations sur les marchés) ;

- promotion d'une agriculture sensible à la nutrition et mise en place de l'environnement alimentaire adapté : mesures d'incitation en faveur de cultures et d'élevages riches en nutriments, enrichissement des aliments et création de valeur ajoutée ; communication et sensibilisation des consommateurs pour favoriser les comportements alimentaires vertueux ;

- incitations financières et mécanismes de partage des risques ;

- systèmes de suivi, de responsabilisation et d'apprentissage ;

- en matière de cultures : développer les protéines végétales ;

- en matière d'élevage et de pastoralisme : travailler sur les races locales ovines, bovines, caprines dont la résilience au changement climatique est prouvée ; développer la ressource fourragère : préserver les espaces pastoraux d'un accaparement par des politiques publiques adaptées, valoriser les espaces agroforestiers ; promouvoir des pratiques de gestion collective des parcours et la maîtrise technique des systèmes d'élevage pour renforcer l'efficacité des systèmes de production et limiter les pertes et gaspillages dans l'utilisation de ressources ; comprendre et accompagner la transformation actuelle du système d'élevage et les nouvelles pratiques développées en réponse au changement climatique et à la succession de sécheresses ; valoriser les produits par la transformation et faciliter l'accès au marché en assurant une rétribution juste et équitablement répartie sur la chaîne de valeur.

MODALITÉS À METTRE EN ŒUVRE :

- approche inclusive de co-construction à l'échelle des territoires, avec les communautés locales ;

- pour tout d'abord définir la trajectoire à adopter sur un territoire donné pour atteindre un système alimentaire durable, inclusif et résilient ; les trajectoires concertées localement ne sont pas identiques mais combinent différemment les leviers évoqués pour identifier des solutions adaptées aux enjeux territoriaux, à court, moyen et long termes ;

- inscription des projets dans le long terme tout en les bornant dans le temps (phases lancées et clôturées qui se succèdent), avec des actions concrètes et quantifiables ;

- structuration par la communauté TSARA d'un agenda scientifique par questions de recherche qui se posent pour répondre de la manière la plus efficace possible aux défis et équations, en identifiant celles qui nécessitent des compétences complémentaires, en présentant ainsi comment, au-delà de la diversité des sujets traités, la communauté s'empare de l'initiative ;

- intégration d'un volet interface science-politique dans cet agenda scientifique : comment TSARA peut contribuer à la construction des trajectoires des pays en prise avec les défis spécifiques identifiés localement ? Comment construire l'interface entre sciences et politiques publiques ?

iii) Table ronde 2 – Avis et recommandations des membres du Comité consultatif externe de TSARA (CCE) pour que TSARA ait un impact

Animation :

Prisca Mugabe, professeure associée, Département des sciences animales, Faculté d'agriculture, d'environnement et des systèmes alimentaires à l'Université du Zimbabwe



Panélistes :

Laurent Bochereau, ministre-conseiller pour la science, la technologie et l'innovation à la Délégation de l'Union européenne auprès de l'Union africaine, Éthiopie



Jannis Dimitriou, président d'Agrinatura et professeur associé à la Swedish University of Agricultural Sciences (SLU), Suède



Janet Maro, cofondatrice et directrice générale de Sustainable Agriculture Tanzania (SAT), Tanzanie



Patrick Okori, secrétaire exécutif du Regional Universities Forum for Capacity Building In Agriculture (RUFORUM), Ouganda



Grandes lignes :

TSARA est une **communauté de recherche** à même de proposer des évidences scientifiques et de contribuer à la formation d'un capital humain pour le futur.

Pour renforcer son impact, TSARA doit être un **hub de connaissances et d'expertises** :

- développant une **recherche participative et ancrée localement** s'appuyant sur des plateformes multi-acteurs/living labs où interagissent praticiens et scientifiques, où jeunes et femmes sont particulièrement mobilisés,

- développant un axe **formation** et soutien aux étudiants,

- **en réseau et en synergie** avec d'autres plateformes, institutions ou initiatives comparables,

- s'attachant notamment à l'étude et à la valorisation des **ressources végétales et animales locales**, aux **marchés et chaînes de valeur**,

- pensant **synthèse de ces résultats et communication**, en travaillant les success stories et formulant un narratif,

- connecté à l'**interface science-politique** à différentes échelles et en particulier au dialogue Union Africaine-Union Européenne (UA-UE),

- pour **convaincre décideurs et secteur privé** de l'importance de soutenir la recherche et obtenir des **financements**, européens par exemple ou par des fondations.

POURQUOI LE CHANGEMENT EST-IL SI DIFFICILE, ALORS QUE LE DÉFI RÉSIDE DANS LA TRANSITION et LA TRANSFORMATION ?

On s'adresse à quelque chose de complexe qui met en jeu différents domaines, différents acteurs. TSARA propose des évidences scientifiques et forme, via les PhD, un nouveau capital humain pour le futur. TSARA peut être fier de ce qui a été fait, avec la participation aux 4 webinaires : déjà de l'impact, pour l'essentiel au sein de la communauté scientifique. Mais que dire des autres communautés qui sont en jeu dans la transition ?

Il faut souligner la faiblesse de l'interaction science – politique dans les débats. Où sont les représentants des ministères ou des agences gouvernementales ? Il faut que TSARA puisse être un hub de connaissances, d'expertises connecté à l'interface science-politique. L'UA et l'UE ont développé une initiative conjointe, sur la FNSSA (Food, Nutrition, Security and Sustainable Agriculture), lancée dès 2016 avec plus de 300 projets financés par H 2020 et H Europe sur 3 sujets : intensification durable, systèmes alimentaires pour la nutrition, expansion des marchés et du commerce. Le renouvellement de la feuille de route est en cours avec 6 experts, 3 Africains et 3 Européens, il sera possible de déposer des commentaires. Allez-y.

Il faut aussi des résultats qui soient exprimés à la bonne échelle, d'une part celle du continent, des organisations de recherche régionales, comme le FARA, d'autre part celles des agences de financement multilatérales, l'UE en est une, mais bien d'autres existent. Enfin, il faut s'appuyer sur des plateformes multi-acteurs, là où les scientifiques et les praticiens interagissent comme les living labs.

Il y a un enjeu fort de dissémination des résultats dans d'autres conférences et forums pour élargir les audiences, mais aussi d'appropriation de ces résultats, pour s'assurer qu'ils sont mis en œuvre sur le terrain en pensant particulièrement aux jeunes et aux femmes, qui ne faut pas laisser de côté. La mise en réseau avec d'autres plateformes, institutions ou initiatives qui travaillent sur l'agroécologie ou les transformations des systèmes alimentaires est nécessaire pour créer des synergies, éviter les doublons, et aussi avoir plus d'impact.

QUELS OUTILS, QUELS FINANCEMENTS QUELLES RESSOURCES ?

Ce que nous avons avec TSARA et ces Science Days, c'est une communauté de recherche. Mais il faut aussi penser synthèse de ces résultats et communication de ces résultats. Par exemple que disons-nous en synthèse des recherches sur la transformation des systèmes alimentaires ? Ce sont deux points très importants, nécessaires pour l'obtention de financements.

Pour accéder à des financements comme ceux de la Fondation Gates, Mastercard et bien d'autres, il faut avoir une histoire à raconter, et c'est là que l'interface science-politique prend de l'importance. Le programme Horizon Europe soutient également le développement des systèmes de connaissances et de conseil (AKIS) pour la FNSSA, TSARA pourrait en bénéficier. Enfin l'IRC for FNSSA - International Research Consortium, coordonné par le FARA -, est aussi une ressource immédiate. La plateforme FNSSA se centre actuellement sur la santé des plantes et la durabilité (l'impact environnemental) des processus de transformation alimentaire. Ce sont des points qui ont été abordés. Mais il y a aussi des opportunités européennes plus bottom-up : les bourses Marie Curie, les staff exchanges, les mobilités Afrique – Europe… Pour tout cela, nous avons besoin d'être ensemble.

Il y a un enjeu sur les ressources financières, il y a également un enjeu autour des compétences, des savoir-faire techniques. Que pouvons-nous construire à partir de ces ressources « immatérielles », comment nous les « africanisons » de façon à être utiles dans le contexte africain. Nous devons travailler à la construction de ces compétences locales, à soutenir les étudiants.

Parmi les ressources, il y a aussi les ressources végétales et animales locales, parfois en voie d'extinction parce que la science a apporté des cultures et aliments exotiques et que nous avons peu exploré, comme chercheurs, nos ressources locales.

SUR QUELS POINTS ORGANISER LES PROCHAINS SCIENCE DAYS ? QUEL(S) FOCUS ?

La recherche translationnelle, ancrée auprès des communautés, participative avec des living labs ou d'autres dispositifs équivalents est une piste à discuter, une étape qui va plus loin que multi/inter/transdisciplinarité. Une recherche avec les jeunes et les femmes localement, engagés dans la conception de solutions avec les chercheurs à la fois de sciences biologiques et de sciences sociales.

Des sujets spécifiques, comme les marchés et les chaînes de valeur, peu évoqués dans ces Science Days sont incontournables.

Les success stories sont à travailler, pour convaincre les leaders politiques d'investir plus dans la recherche, pour créer de la valeur et contribuer à trouver des solutions sur des sujets prégnants pour l'Afrique.

iv) Synthèse de la session – Norman Maïvashe

Pour rappeler brièvement le chemin parcouru, nous avons entamé une série de sessions au début du mois, en commençant par les sessions 1, 2 et 3, qui nous ont permis d'approfondir trois domaines thématiques : les transitions agroécologiques, la durabilité des systèmes alimentaires et les interactions entre ces deux domaines thématiques importants. Et ce matin, dès le début, nous avons indiqué que l'objectif de la session d'aujourd'hui était d'examiner toutes les informations recueillies au cours des trois sessions précédentes, d'en synthétiser les résultats afin d'identifier une orientation, des pistes de recherche, des actions et peut-être des projets visant à renforcer l'impact de TSARA. Et vous conviendrez avec moi que c'est effectivement ce que nous avons fait aujourd'hui.

Pour résumer, nous avons écouté et visionné les vidéos qui mettent en avant l'excellent travail réalisé par le TSARA. Nous avons également pris connaissance d'un très bon compte rendu des trois sessions.

Je ne vais pas m'étendre sur ces points. Il suffit de dire que les transitions agroécologiques ont été mises en avant et que cela a souligné la nécessité pour nous de repenser ou d'examiner de près les 13 principes de l'agroécologie afin de nous assurer que ces principes soient enrichis et qu'ils soient plus inclusifs. La session a également mis en évidence un décalage manifeste : ce qui se passe sur le terrain en termes de principes retenus ne couvre pas l'ensemble des 13 principes. Par ailleurs, un besoin a été mis en avant concernant la manière dont nous devrions envisager l'agroécologie, à savoir en la considérant comme un moteur du développement rural. Quant aux systèmes alimentaires durables, il y a eu une reconnaissance de la diversité des systèmes alimentaires ainsi que la nécessité d'examiner l'ensemble des outils disponibles en termes d'approches que nous allons utiliser pour mener la transition et le changement. Il a également été souligné qu'il existe un besoin d'intégrer l'agroécologie, l'inclusion sociale et les systèmes alimentaires durables.

La session interactive a également été très enrichissante. Nous avons pu une nouvelle fois identifier les priorités telles que la diversité, la résilience et le financement. Les participants ont évalué toutes les sessions. L'une de leurs suggestions a été d'envisager une session hybride, ce qui me semble être une bonne idée.

En ce qui concerne les tables rondes, je pense que les discussions ont été très enrichissantes. Nous avons identifié les défis évoqués par les différents intervenants. Parmi les points qu'ils ont mis en avant, il y avait notamment la nécessité de se pencher sur les contraintes de financement, en particulier en ce qui concerne le travail de développement mené dans le secteur public ou par les organisations qui ont donné la priorité au développement, et la nécessité de trouver un équilibre entre les priorités stratégiques à long terme et les réalités de la gestion de projet. Quant aux leviers d'action, la technologie, et plus particulièrement la technologie numérique, a été identifiée comme un domaine à privilégier, tout comme la nécessité d'adopter une agriculture respectueuse du climat. Le tableau dressé concernant l'élevage a montré qu'il existe une demande croissante pour que le système alimentaire réponde au défi posé par la désignation de l'élevage comme l'un des principaux facteurs du changement climatique — un point qui doit également être abordé. La gestion des systèmes pastoraux a quant à elle été désignée comme un domaine à examiner. Parmi les messages clés à retenir de la première table ronde, il a été souligné que l'agriculture durable était la voie à suivre, en s'intéressant à l'agriculture végétale mais aussi à l'élevage. L'opportunité offerte par les OGM a également été examinée, tout en trouvant un équilibre avec les solutions fondées sur la nature et en tenant compte de la nécessité de tirer parti de l'interface entre la science et la politique.

La deuxième table ronde a quant à elle abordé des questions importantes pour la plateforme. Il a été reconnu que la plateforme TSARA joue un rôle important, mais qu'il existe une marge d'amélioration. Certains des défis auxquels TSARA est confrontée ont été mis en évidence, ainsi que certaines solutions que nous proposons, notamment en ce qui concerne le renforcement de l'interface entre la science et la politique, qui est actuellement faible, et la nécessité de veiller à ce que les résultats ne soient pas réservés à cette petite communauté, mais qu'ils soient diffusés à plus grande échelle afin d'être accessibles à une communauté plus large, une communauté qui pourrait en bénéficier. Le ciblage de partenaires multinationaux spécifiques, et en particulier celui des gouvernements africains, a été identifié comme un axe important. Il a également été souligné que, pour attirer des financements, nous devons être en mesure de mettre l'accent sur les réussites. Un autre axe concernait les opportunités existantes en matière d'intensification durable. Les travaux présentés dans le cadre de l'initiative de l'Union européenne constituent un élément que nous devrions prendre en considération. Un autre axe, qui constitue une opportunité à portée de main, concernait le pôle de connaissances que nous créons via la plateforme ; il a été souligné qu'il fallait le rendre plus accessible afin d'assurer notre efficacité. En ce qui concerne les ressources, la nécessité de synthétiser les résultats de la recherche pour une communication efficace a été mise en avant. Il a également été indiqué qu'il n'était

pas nécessaire de réinventer la roue, mais qu'il fallait veiller à adapter toute technologie existante aux conditions locales. L'engagement actif d'autres parties prenantes au-delà de la communauté a été mis en avant comme un axe à explorer.

En ce qui concerne les enjeux à prendre en compte lorsque nous proposons d'autres opportunités d'engagement, il a été souligné que nous sommes confrontés à une transition et qu'il est donc nécessaire d'envisager d'autres approches telles que la recherche transdisciplinaire, multidisciplinaire, etc. Pour ma part, en tant que président de cette session, je pense que nous pouvons vraiment être fiers d'avoir pu nous engager de cette manière.

Il est très clair que TSARA est une plateforme précieuse, mais il nous faut peut-être réexaminer le chemin que nous avons parcouru et les processus que nous avons mis en place, car certains d'entre eux ne sont peut-être pas aussi adaptés à leur objectif que d'autres. Peut-être devons-nous simplement passer en revue notre boîte à outils afin de continuer à renforcer la valeur de TSARA. Et je tiens à remercier tous ceux qui ont participé à cette session et l'ont rendue si enrichissante. Pour ma part, merci beaucoup d'avoir été un public aussi formidable.

CLÔTURE

Fouad Rachidi, directeur adjoint à la recherche-coopération, ENA Meknès, Maroc, représentant le DG et coprésident de TSARA



Mesdames et Messieurs,

Chers collègues, chers participants et participantes,

C'est avec un profond sentiment de satisfaction et d'espoir que je prends la parole aujourd'hui pour clore cette première édition des « Science Days », organisée dans le cadre de l'initiative TSARA.

Les trois thématiques au cœur de nos débats — l'agroécologie, le système alimentaire, et surtout leur interaction dynamique — sont au centre des défis contemporains auxquels nos sociétés sont confrontées : sécurité alimentaire, résilience face au changement climatique, justice sociale, souveraineté alimentaire et durabilité des écosystèmes. À travers des interventions scientifiques de grande qualité, des séances posters riches en contenu, des échanges stimulants et des perspectives ambitieuses, nous avons pu mesurer à quel point la recherche, l'enseignement et l'innovation doivent être mobilisés ensemble, de manière transdisciplinaire, inclusive et ancrée dans les réalités locales.

Ces quatre sessions en ligne ont été bien plus qu'un simple partage de connaissances : elles ont constitué un véritable espace de dialogue scientifique, de réflexion critique et de co-construction, autour des enjeux fondamentaux qui façonnent notre avenir agricole et alimentaire.

Je tiens à exprimer mes remerciements les plus sincères à toutes celles et ceux qui ont rendu cet événement possible. Un merci particulier à l'équipe organisatrice, dont l'engagement, la rigueur et la créativité ont permis de concevoir et de mener à bien ces journées scientifiques avec excellence. Je pense notamment aux membres du Secrétariat, au Copil des Science Days, ainsi qu'à tous ceux ou celles qui ont travaillé dans l'ombre pour porter ce projet avec passion et détermination.

Je remercie également tous les présidents et coprésidents de sessions, les intervenant(e)s, les modérateurs, les animateurs, ainsi que l'équipe technique, dont le travail discret mais essentiel a assuré le bon déroulement de chaque session.

Je saisis cette occasion pour saluer chaleureusement l'ensemble des participants. Votre mobilisation a dépassé nos attentes : 680 inscrits, issus de 67 pays — africains, européens, latino-américains, nord-américains, asiatiques — et représentant 316 institutions. Parmi eux, 68 % proviennent d'organismes de recherche ou de formation, tandis que Ministères, ONG, organisations internationales, secteur privé et organisations paysannes sont également bien représentés. La proportion linguistique — 60 % francophones et 40 % anglophones — témoigne de la vocation bilingue et inclusive de TSARA. Selon les sessions, nous avons compté entre 150 et 250 participants connectés simultanément, ce qui illustre un engagement constant et une curiosité intellectuelle remarquable.

Cette diversité géographique et disciplinaire a considérablement enrichi nos débats, grâce à vos expertises, votre ouverture d'esprit, votre patience face aux aléas techniques inévitables, et surtout votre volonté commune de faire avancer la cause d'une agriculture et d'un système alimentaire plus justes, durables et résilients.

Permettez-moi enfin de saluer une fois encore notre partenaire historique, le CIRAD, co-président de TSARA, et plus particulièrement Monsieur Jean-Paul Laclau, Directeur général adjoint chargé de la

Recherche et de la Stratégie, pour son discours d'ouverture inspirant, qui a parfaitement posé les bases de nos réflexions.

L'initiative TSARA incarne précisément ce que doit être la collaboration scientifique internationale : ancrée localement, pensée globalement, et toujours tournée vers l'action concrète.

Que cette première édition des « Science Days » ne soit pas une fin, mais un nouveau départ — vers davantage de projets collaboratifs, de formations innovantes, de recherches engagées et de politiques publiques éclairées.

Pour concrétiser cette ambition, plusieurs actions suivront immédiatement :

- Un questionnaire en ligne d'évaluation et de perspectives sera diffusé ; merci d'y répondre, même brièvement : vos retours seront précieux pour préparer la suite ;
- Les actes des « Science Days » seront publiés et mis à disposition, incluant replays, diaporamas, posters, et contributions destinées à des numéros spéciaux de revues scientifiques ;
- Lors de l'Assemblée Générale de Nairobi, un espace dédié valorisera les «Science Days» et proposera des temps d'échange scientifique directement inspirés de cette expérience.

Je rappelle aussi que TSARA est ouverte à toute initiative émanant de ses membres — que ce soit pour améliorer, innover ou renforcer la coopération dans le cadre de cette dynamique collective.

Enfin, l'École Nationale d'Agriculture de Meknès réaffirme son plein engagement aux côtés de tous les acteurs de TSARA pour porter ensemble cette vision ambitieuse et nécessaire.

Je vous remercie.

DÉBRIEFING

Les éléments suivants sont une synthèse issue de :

- deux réunions de débriefing ayant rassemblé 21 personnes parmi les membres des comités de pilotage et scientifique, les président(e)s et co-présidents de sessions, les animateur(trice)s de tables rondes, l'équipe d'animation et l'équipe d'appui technique ;

- retours individuels divers ;

- réponses au questionnaire en ligne post-Science Days/Bilan et de mise en perspective auquel 43 personnes ont répondu (28 FR, 15 EN).

i) Un bilan positif pour cette première édition

▪ **En matière de mobilisation et de dynamique partenariale**

- importance du **travail d'équipe** mené, forte mobilisation de partenaires de TSARA pour la préparation et la mise en œuvre (cf. annexe 1) ;

- **diversité** des institutions présentes et des pays représentés, **participation importante** et maintenue sans trop de perte au fil des sessions (cf. annexes 3 et 4) ;

- jalon utile pour **faire connaître TSARA**, le travail réalisé et les partenaires impliqués, la plus-value de TSARA en tant que plateforme rassemblant des chercheurs, jeunes et moins jeunes du Sud et du Nord, **renforcer la communauté TSARA**, **connecter** des personnes, des pays, des acteurs, des territoires ;

- **volonté exprimée de poursuivre** les interactions/les échanges/l'engagement/les collaborations afin de traduire collectivement les discussions en résultats concrets (cf. § 3 et 4).

▪ **En matière de format et d'organisation**

- combinaison de **séquences différentes** (questionnaire, présentation des auteurs, tables rondes) constituant des sessions vivantes et dynamiques ;

- séquences de **questionnaire préparées et animées par les étudiants** très appréciées : interactif, innovant, ludique, riche, informatif, utile pour ouvrir les sessions et avoir une vue globale des paysages (ex : tableau des initiatives, réseaux, projets menés en lien avec l'agroécologie) ; formule adoptée face à un timing serré pour préparer les « paysages » avec les étudiants en amont des Science Days ; en regard, l'absence in fine de keynote speakers ne semble pas avoir posé problème ;

- bonne **gestion technique et logistique** face au défi de la densité de contenu et du nombre d'intervenants (coordination des orateurs, des panels et des salles plénière/parallèle) ;

- **mobilisation fluide** de l'ensemble des participants et des orateurs sous la houlette très efficace des **présidents et coprésidents de sessions** ;

- **traduction simultanée** très appréciée ;

- utilité de la réunion de cadrage des présidents et coprésidents pour partager les questions et informations et éclaircir les points qui le nécessitaient.

▪ **En matière de contenus**

- **diversité, richesse et dimension concrète/pratique des travaux présentés**, des points de vue, des priorités de recherche, des disciplines mobilisées, en lien avec la richesse des réponses au **call for abstracts** ;

- sujets et **contenus scientifiques intéressants**, cohérents, utiles, de bonne qualité scientifique, couvrant de nombreux aspects de chacune des thématiques, donnant à voir la richesse du travail fait sur le terrain, et bien présentés (apports en matière de durabilité, résilience, sécurité alimentaire et nutritionnelle, production locale ; simulation intéressante de différents scénarios de transition agroécologique incluant des aspects d'investissements financiers ; dimensions transversales, culturelles et politiques des diètes abordées avec les questions de nutrition, microbiote, sécurité alimentaire) ;

- 4ème session ouvrant la tribune à **différents panélistes** permettant des *discussions riches et tournées vers l'avenir, un échange précieux de points de vue et de recommandations pratiques, une expérience d'apprentissage significative, un espace constructif de dialogue entre la science, la politique et la pratique* [point de vue nuancé infra].

ii) Les points perfectibles

▪ **Difficulté principale : la densité des sessions, le nombre de présentations et donc la gestion du temps :**

- timing finalement à peu près maîtrisé (20' de retard sur les 3 premières sessions), mais au prix d'une **forte pression** sur les présidents, coprésidents, animateurs de tables rondes contraints d'interrompre les collègues, et sur les orateurs donc, d'une **moindre place pour l'expression** de chacun, l'approfondissement de leurs présentations/expressions, le dialogue ;

- pour certains la frustration de devoir **choisir l'une des sessions parallèles** (et peut-être un déséquilibre avec plus de personnes restant en plénière et moins basculant sur la salle parallèle/session parallèle B).

▪ **Peu de questions dans le Q&R** de la part de l'audience dans les sessions parallèles (allant cependant croissant au fil des sessions ; peut-être expliciter plus le fonctionnement de la boîte Q&R) ; la très bonne préparation de ces moments dévolus aux questions par les co-présidents, qui ont complété par leurs propres questions, a permis de compenser le peu de questions du public.

▪ Pour la **session poster** : la musique était belle [Geoffrey Oryema, Land of Anaka, courtesy accordée] mais il aurait été préférable que les auteurs puissent expliciter le poster au fur et à mesure de son passage, en 1 à 2' [l'idée initiale de la musique était de procurer un petit temps plus calme].

▪ **Traitement du sujet Transition agroécologique** et explicitation du lien entre transition agroécologique et systèmes alimentaires durables diversement appréciés avec des gaps : *6 à 7 principes de l'agroécologie ont été présentés, c'est un bon début / tous les principes de l'agroécologie n'ont pas été abordés ; apport d'éléments sur le lien TAE/SFS et sur le lien agroécologie-sécurité alimentaire / lien insuffisamment montré ; défis environnementaux insuffisamment intégrés dans la session systèmes alimentaires durables (liens agriculture/nutrition/environnement-protection de la biodiversité).*

▪ **4ème session** perçue par certains comme apportant à nouveau du contenu plus qu'une synthèse des sessions précédentes et l'identification claire de perspectives.

iii) Suites à donner

▪ **Questionnaire d'évaluation et perspectives** à destination des participants : il doit être court, solliciter un feed back mais se concentrer surtout sur les perspectives (que faire dans la suite des Science Days ? comment envisager les prochains Science Days ?).

▪ **Point sur les porteurs d'abstracts** à reprendre (qui, d'où, quels sujets, quels partenariats mis en valeur, quelles connexions possibles entre auteurs), en complément du point sur les inscrits et les participants (cf. annexes 3 et 4).

▪ **Élaboration collective des Actes des Science Days**, au sens large, incluant : synthèse écrite de chacune des 4 sessions et synthèse des synthèses avec les messages-clés en termes de science, de partenariat, de perspectives et recommandations ; panorama et détail des participants ; replays et diaporamas des 4 sessions ; résumés des auteurs [à remettre en forme et consolider] ; peut-être/si possible un petit film présentant les Science Days (~5' d'extraits d'interventions ?).

Les actes doivent être finalisés si possible en mars, **en amont de l'AG de Nairobi** (13-15/5) : pour nourrir l'éventuelle actualisation de l'agenda scientifique et du plan d'action de TSARA (potentiels projets collaboratifs notamment) ; lors de l'AG elle-même un temps sera consacré à la restitution des Science Days ; nous prévoyons par ailleurs des temps d'échange scientifique qui peuvent être inspirés d'enseignements des Science Days et approfondir certaines questions.

L'ensemble de la boucle mobilisée pour les Science Days est sollicitée pour contribuer aux Actes : merci à chacun selon la nature de son implication et sa disponibilité d'indiquer ses possibilités de contribution et/ou de transmettre sa contribution (exemple note de synthèse d'une session parallèle). NB : l'importance et l'intérêt pour les CV de figurer parmi les auteurs des actes sont soulignés. Les actes seront revus avec le comité scientifique.

Les actes doivent permettre **:**

- de **valoriser le travail collectif** réalisé, en mettant un accent particulier sur la valeur ajoutée des Science Days,

- à chacun de reprendre plus tranquillement **la richesse des contenus** et faire le point sur certains d'entre eux (ex : identifier les principes de l'agroécologie bien abordés lors des Science Days et ceux qui manquent, et prévoir de discuter de la signification de ces gaps),

- identifier les contenus à porter à la connaissance des décideurs politiques, à traduire en **policy briefs** ; identifier les contenus pouvant faire l'objet de **numéros spéciaux** ;

- mobiliser **un(des) groupe(s) de volontaires, associant chercheurs seniors et étudiants, pour écrire** un(des) papier(s) ; établir des consortia entre auteurs à intérêt partagé ; la publication est une démarche de long terme qui requiert la mobilisation d'une équipe motivée (plusieurs collègues déjà portés volontaires) ;

- **communiquer en interne TSARA**, faire du lien avec les chercheurs au sein de nos organismes respectifs, **et en externe** (diffusion des actes notamment sur le site TSARA, publications).

▪ **Pérenniser et faire fructifier le réseau constitué avec les Science Days sur la base et au-delà de TSARA** :

- conforter **le collectif TSARA** existant (36 membres, certains très présents aux Science Days, d'autres moins – à discuter avec eux -) et être **ouvert** aux collègues souhaitant rejoindre l'initiative, s'impliquer et contribuer à la dynamique ; échanger avec les partenaires européens ayant assisté aux Science Days pour avancer sur leur implication dans TSARA ;

- soutenir de **nouvelles collaborations** entre auteurs dont les travaux sont proches, construire des **réseaux thématiques en particulier de doctorants** et des espaces de mentorat ;

- organiser des échanges thématiques, identifier des **contenus de nature à être partagés** au travers de « formation »/de webinaires ;

- s'appuyer sur les livrables pour soutenir le **financement de projets** ; identifier des sources permettant de financer la contribution d'étudiants lors de ce genre d'échanges scientifiques (effective ici avec la présentation de nombreux travaux d'étudiants et la séquence questionnaire) et des formats de travail conjoint d'étudiants.

iv) Enseignements et pistes pour les prochains Science Days

▪ Après cette première édition, **l'intérêt des TSARA Science Days et le principe de les organiser régulièrement sont validés** (parmi les propositions remontées : organisation chaque année, et congrès scientifique organisé en présentiel porté par TSARA tous les 3 ans, potentiellement couplé à l'AG).

▪ **Sujets** à traiter : s'attacher aux gaps, à ce qui est insuffisamment pris en charge ou a pu manquer lors de ces premiers Science Days (gaps thématiques et méthodologiques) ; cf également les résultats bruts du sondage de la session 4 (PJ).

Une idée à creuser : demander à tous les **projets financés par TSARA** de soumettre au moins un résumé ou une présentation pour ces journées scientifiques, soit pendant le projet, soit à la fin de celui-ci. Cela pourrait légèrement allonger la durée des sessions, mais permettrait d'offrir un mélange de contributions provenant des partenaires de TSARA et de celles élaborées conjointement dans le cadre de l'initiative.

▪ **Programme et format** :

- programme **moins chargé, laissant plus de temps pour l'approfondissement et les échanges**/le dialogue, notamment lors des tables rondes afin de permettre aux panélistes d'exprimer leurs avis de façon plus approfondie ;

- moins de **présentations** [supposant moins de diversité de points de vue et d'inclusivité] ?

- imaginer **un thème pour chaque Science Day**, en centrant les interventions sur une question importante ;

- **plus de sessions parallèles** pour accorder plus de temps à chaque présentation ? **Ou pas de sessions parallèles** pour ne pas avoir à choisir et pouvoir écouter toutes les présentations en une seule plénière ? Les avis divergent ;

- non pas 4 **sessions de 2h30** mais 2 journées pleines (8h-15h UTC, 11h-18hEAT pour des participants d'Afrique et d'Europe ; plus compliqué pour les collègues ailleurs dans le monde – cf. § annexe 3 : Amérique, Asie-) ;

- une **table ronde multi-acteurs** (scientifiques, politiques) dans chaque session pour renforcer le dialogue ?

- **séquence posters** le cas échéant organisée avec un commentaire des auteurs pour des passages de 1 à 2' par poster, et en mobilisant des outils interactifs existants [à préciser] ; une solution pourrait

consister à proposer des posters en ligne et à organiser une ou plusieurs sessions de présentation au cours desquelles, pour chaque poster (sélectionné), une seule diapositive expliquerait pourquoi il vaut la peine de le consulter ou présenterait son résultat principal ;

- pas de synthèse à chaque session des sessions précédentes, uniquement en dernière session (principe adopté pour la session 3 après avoir constaté la redondance lors de la session 2) ;

- un positionnement dans l'année détaché des **périodes de break annuel** (fin d'année pour l'Afrique australe, milieu d'année pour l'Afrique plus au nord et l'Europe).

QUESTIONNAIRE POST SCIENCE DAYS

Synthèse réalisée avec l'aide de https://assistant.numerique.gouv.fr/ sur la base des réponses au questionnaire en ligne (43 réponses, 28 pour la version française, 15 pour la version en anglais).

1. Attentes et objectifs

- **Satisfaction globale** : Les participants estiment que les Journées ont **répondu à leurs attentes**, voire les ont **dépassées** pour certains.
    - **Clarification des orientations** : Les objectifs de TSARA (vision scientifique, partenariats, thématiques prioritaires) ont été mieux compris.
    - **Opportunités de réseautage** : Renforcement des liens entre chercheurs, institutions et disciplines (Nord-Sud, Europe-Afrique).
    - **Diversité des attentes** :
        - Découverte des travaux en cours (ex. : agroécologie, systèmes alimentaires durables).
        - Partage de connaissances et identification de collaborations potentielles.
        - Implication dans des projets concrets (montage de projets, formations, publications).
- **Attentes non comblées** :
    - Certains regrettent un **manque de profondeur** sur des sujets spécifiques (ex. : genèse de TSARA, gouvernance, durabilité au sens large).
    - **Temps insuffisant** pour approfondir les échanges ou présenter des travaux (notamment pour les posters).

2. Contenus scientifiques

☑ **Points forts**

- **Rigueur et qualité** :
    - Présentations **scientifiquement solides**, avec des approches méthodologiques variées.
    - **Diversité thématique** : Agroécologie, One Health, numérique, changement climatique, systèmes alimentaires, etc.
    - **Interdisciplinarité** : Croisement des disciplines (sciences sociales, agronomie, écologie, etc.).
- **Pertinence des sujets** :
    - Thèmes alignés sur les **enjeux globaux** (transition agroécologique, sécurité alimentaire, adaptation climatique).
    - Mise en avant des **travaux innovants** (recherche participative, modélisation, solutions locales).

🔍 **Axes d'amélioration**

- **Focalisation** :
    - **Réduire la portée** pour éviter une dilution des discussions. Propositions :
        - Regrouper les thèmes par **région** (Afrique, Europe) ou **discipline**.
        - Sélectionner des **présentations plus ciblées** (ex. : appel à résumés évalués par un comité scientifique [NDLR : c'était bien le cas]).
    - **Thèmes à renforcer** :
        - **Adaptation au changement climatique** et **atténuation**.
        - **Agriculture numérique** et **modélisation**.
        - **Genre et agroécologie** (meilleure intégration des questions de genre).
        - **Politiques publiques** : Panorama par pays, évaluation quantitative, implication des décideurs.

        - **Recherche appliquée** : Cas concrets d'adoption de pratiques agroécologiques, retours d'expérience (succès et échecs).
- **Équilibre** :
    - **Moins de présentations**, mais **plus approfondies** (ex. : 10-15 min de présentation + 5-10 min d'échanges).
    - **Meilleure représentation** des travaux africains et des chercheurs locaux.

3. Format et organisation

☑ Points positifs

- **Accessibilité** :
    - Format **virtuel** ayant permis une **participation large** (institutions variées, pays africains et européens).
    - **Flexibilité** : Sessions réparties sur plusieurs jours pour accommoder les fuseaux horaires.
- **Structure** :
    - Programme **bien organisé**, avec un enchaînement logique des présentations.
    - **Sessions plénières et parallèles** appréciées pour leur complémentarité.

⚠ Limites

- **Interactions limitées** :
    - **Temps insuffisant** pour les discussions, les questions/réponses et le réseautage.
    - **Format unidirectionnel** (présentations "à la queue leu-leu") peu propice aux échanges spontanés.
    - **Sessions trop denses** : Difficulté à suivre l'intégralité des présentations (notamment les posters).
- **Problèmes logistiques** :
    - **Connectivité** : Difficultés techniques pour certains participants (ex. : mauvaise connexion en Afrique).
    - **Fuseaux horaires** : Plages horaires peu adaptées à tous (ex. : 12h-15h UTC).
    - **Traduction** : Besoin de **dispositifs de traduction** plus robustes pour inclure les non-anglophones.

💡 Recommandations

- **Format hybride** :
    - Combiner **présentiel** (pour les échanges informels) et **virtuel** (pour l'accessibilité).
    - Organiser des **sessions parallèles** pour couvrir plus de thèmes en profondeur.
- **Améliorer les échanges** :
    - **Allouer plus de temps** aux discussions (ex. : 50% du temps dédié aux Q&A et débats).
    - **Ateliers pratiques** : Travail en petits groupes sur des projets concrets.
    - **Retours d'expérience** : Partager des **succès et échecs** pour inspirer les participants.
- **Posters** :
    - Remplacer les sessions posters classiques par des **présentations flash** (3-5 min) suivies de discussions.
    - **Évaluer les posters** et récompenser les meilleurs (prix, mentions).
- **Durée** :
    - **2-3 jours consécutifs** (ex. : 8h-15h UTC / 11h-18h EAT) pour les participants africains et européens.
    - Alternative : **4 sessions de 2h30 réparties sur 2 semaines** pour éviter la fatigue [NDLR : c'était le format de ces Science Days].

4. Partenariats et collaboration

☑ Réussites

- **Renforcement des liens** :

    - **Partenariats institutionnels** consolidés (universités, centres de recherche, ONG).
    - **Collaborations Nord-Sud** et **interdisciplinaires** (ex. : co-écriture d'articles, projets communs).
    - **Réseautage** : Identification de partenaires potentiels pour des projets futurs.
- **Diversité des acteurs** :
    - Implication de **chercheurs, décideurs politiques, industriels, agriculteurs** et **étudiants**.

🔍 **Axes d'amélioration**

- **Suivi post-événement** :
    - Créer des **groupes de travail thématiques** (ex. : agroécologie, eau, One Health) avec des **feuilles de route claires** [NDLR : ce sera fait dans le cadre de la relance des Task forces thématiques – TFT-]
    - **Faciliter l'accès aux financements** : Lister les bailleurs de fonds et opportunités de financement (ex. : Horizon Europe, appels à projets locaux).
    - **Annuaire des participants** : Diffuser une **liste des participants** (avec mots-clés, publications, contacts) pour favoriser les collaborations.
- **Inclusion** :
    - **Impliquer davantage les jeunes chercheurs** (doctorants, post-doctorants) via des **sessions dédiées** ou du mentorat.
    - **Intégrer les agriculteurs** : Leur donner la parole pour partager leurs **perceptions et besoins**.
    - **Équilibre genre** : Veiller à une **représentation équitable** des femmes dans les interventions et l'organisation [NDLR : dimension prise en compte lors de ces 1st Science Days]
- **Partenariats techniques et financiers** :
    - **Mobiliser plus de bailleurs de fonds** (publics et privés).
    - **Collaborer avec des acteurs locaux** (ex. : CILSS, organisations paysannes).

5. Points forts globaux

- **Qualité scientifique** : Niveau élevé des présentations et des échanges.
- **Diversité** :
    - **Thématique** : Large éventail de sujets couverts.
    - **Géographique** : Participation de chercheurs issus de **plusieurs continents** (Afrique, Europe, Amérique).
    - **Institutionnelle** : Implication d'**universités, centres de recherche, ONG, et industries**.
- **Clarté stratégique** : Meilleure compréhension des **priorités de TSARA** et des **synergies possibles**.
- **Engagement** : Dynamique forte créée autour de la communauté TSARA.

6. Suites à donner

📄 **Publications et diffusion**

- **Actes de conférence** :
    - Publier des **articles scientifiques** (évalués par les pairs) dans une collection dédiée (ex. : HAL).
    - Produire un **livre blanc** ou une **synthèse des principales conclusions**.
    - Diffuser les **présentations et résumés** sur une plateforme commune (ex. : site web de TSARA).
- **Outils de communication** :
    - **Newsletter trimestrielle** : Mises à jour sur les projets, appels à projets, opportunités de collaboration.

    - **Plateforme collaborative** : Espace pour partager des données, des publications et des outils.

🎓 **Renforcement des capacités**

- **Formations** :
    - Ateliers sur la **rédaction de projets**, l'**analyse de données**, ou la **modélisation**.
    - **Écoles d'été** ou **cours en ligne** sur des thèmes clés (ex. : agroécologie participative).
- **Mentorat** :
    - Programmes pour **jeunes chercheurs** (accompagnement par des seniors).

🤝 **Structuration des collaborations**

- **Groupes de travail** :
    - Créer des **groupes thématiques** (ex. : agroécologie, eau, One Health) avec des **réunions régulières**.
    - Organiser des **webinaires thématiques** pour maintenir l'élan.
- **Projets communs** :
    - **Appels à projets internes** pour financer des collaborations émergentes.
    - **Partenariats avec des bailleurs** : Identifier des financements alignés sur les thèmes de TSARA.

🌍 **Interface science-politique**

- **Implication des décideurs** :
    - Organiser des **sessions dédiées** aux politiques publiques (présentations par pays, débats).
    - Créer un **groupe de travail "science-politique"** pour faciliter le dialogue.
- **Plaidoyer** :
    - **Sensibiliser les institutions** (gouvernements, ONG) sur l'importance de la recherche agroécologique.

7. Périodicité

- **Préférence majoritaire** : **Annuelle** (pour maintenir la dynamique).
- **Alternative** : **Bisannuelle** (pour permettre une **préparation plus approfondie** et un impact plus fort).
- **Autres propositions** :
    - **Sessions trimestrielles** (webinaires thématiques).
    - **Événements régionaux** (ex. : Science Days par zone géographique).

8. Implications personnelles

- **Engagement des participants** :
    - **Volonté de s'impliquer** dans les **groupes thématiques de TSARA** (ex. : agroécologie, Une seule santé, numérique).
    - **Contributions proposées** :
        - Participation à des **recherches collaboratives**.
        - Organisation de **webinaires** ou d'**ateliers**.
        - Développement de **projets communs** (montage, financement).
        - **Formation** : Animation de sessions ou mentorat.
        - **Interface science-politique** : Contribution aux discussions et à la rédaction de propositions.
- **Attentes individuelles** :
    - **Reconnaissance** : Certains demandent des **certificats de participation** ou des **attestations**.
    - **Accès aux ressources** : Partage des **présentations, actes, et contacts** pour faciliter les collaborations.

📊 Conclusion et recommandations clés

Aspect	Forces	Améliorations prioritaires	Actions concrètes
Contenu	Multidisciplinarité, rigueur	Thèmes plus focalisés, présentations sélectionnées	Appel à résumés, comité scientifique, intégration de thèmes émergents (genre, numérique).
Format	Accessibilité (virtuel)	Hybride, sessions parallèles, temps étendu	2-3 jours hybrides, ateliers pratiques, présentations flash pour les posters.
Partenariats	Réseautage, nouvelles collaborations	Suivi structuré, inclusion des jeunes chercheurs	Groupes de travail, annuaire des participants, mentorat.
Équité	Diversité des participants	Meilleure représentation africaine et genre	Quotas, traduction, sessions dédiées aux chercheurs locaux.
Outputs	Échanges riches	Publications, rapports, formations	Actes de conférence, newsletter, plateforme collaborative, ateliers de formation.
Périodicité	Dynamique annuelle	Équilibre entre fréquence et profondeur	Événement annuel + webinaires trimestriels.

Prochaines étapes pour TSARA :

4. **Affiner la focalisation** des Science Days (thématique ou régionale).
5. **Améliorer l'engagement** via des formats hybrides et des discussions approfondies.
6. **Pérenniser la dynamique** :
    - Créer des **groupes de travail thématiques**.
    - Organiser des **webinaires de suivi**.
    - Publier des **actes et synthèses**.
    - **Former et mentorer** les jeunes chercheurs.

Message final : Les Journées Scientifiques TSARA ont **réussi à fédérer une communauté engagée** autour de l'agroécologie et des systèmes alimentaires durables. Pour **capitaliser sur ce succès**, il est essentiel de **structurer les suites** (publications, groupes de travail, formations) et d'**adapter le format** pour maximiser les échanges et l'impact.

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SESSION 1: AGROECOLOGICAL TRANSITION

Session chair: **Sonia Bedhiaf**, INRAT, Tunisia

Parallel session A - Approach

(territories, co-design, living labs, participative, support, governance, policy, scaling)

Chaired by **Geneviève Dione**, ISRA, Senegal

Parallel session B - Practices

(practices, tools, technologies, process)

Chaired by **Nadine Andrieu**, Cirad, France

Speakers, institutions & concerned countries

Frank CHIDAWANYIKA, *icipe,* Kenya et al
Cédric GAUCHEREL, INRAE, Burkina Faso
Calypso BEAUCHAMP, INRAE, Morocco, Uganda, Tunisia
Isabelle ALVAREZ, INRAE, Senegal
Der DABIRE, CIRDES, Burkina Faso
Tobi AKINROPO, INRAE, Nigeria & al
Jérôme HARMAND, INRAE, Tunisia, Morocco
Ambaye KEBEBA, AAU, Ethiopia
Koyo Nzala REMICHE IVALDA & &Kamila CANALE TABET, INRAE, Côte d'Ivoire
Samia KHNISSI, INRAT, Tunisia
Younouss CAMARA, UGB, Senegal
Gwenaëlle LASHERMES, INRAE, Zimbabwe
Jérôme SALSE, INRAE, Egypt
André GADJI, CNRA, Côte d'Ivoire
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Suzanne TOUZEAU, INRAE, Cameroon
Kiwoong NAM, INRAE
Emile BOLOU BI Bolou, INPHB, Côte d'Ivoire

Parallel session A – Approach (territories, co-design, living labs, participative, support, governance, policy, scaling)

Towards food systems transitions through a regional multi-actor research network for agroecology in East Africa (RMRN-EA)

Chidawanyika Frank

International Centre of Insect Physiology and Ecology (icipe), Kenya

Farming in East Africa is non-monolithic, featuring diverse farming systems dominated by smallholder-based, rainfed agriculture. These farming systems range from highland perennial farming (e.g. banana-coffee), mixed maize farming (maize with beans, cassava or vegetables), agroforestry systems to livestock-based systems. Despite such diverse farming practices, the region remains constrained by socioeconomic factors and environmental challenges, including climate change and land degradation, leading to food insecurity and poverty. The response to these challenges has often been hampered by various factors, including lack of context-specific and co-created innovations, limited research and extension capacity among national institutions, a non-conducive policy environment and lack of tailored curricula that sustainably address challenges in agriculture and food system transformation. Through funding from the European Commission, a regional multi-actor research network on agroecology in East Africa (RMRN-EA) was formed with as goal to contribute to a sustainable agri-food system transition based on agroecological principles and practices in sub-Saharan Africa. An agroecological approach to capacity building entails a holistic and integrated approach that simultaneously applies ecological, social, cultural, technological, economic and political dimensions of agriculture, along the entire value chain. Specifically, the RMRN-EA implements the following actions in Kenya, Tanzania and Uganda: (1) develop and implement curricula on agroecology with universities, (2) strengthen the capacities to conduct and collect data on agroecology of research organizations, (3) co-create, validate and scale agroecological innovations with communities through living labs; and (4) create advocacy and build capacity in agroecology of policy makers and other decision makers with a gender-sensitive approach. Through these multipronged participatory approaches, RMRN-EA targets various beneficiaries including universities, national research and extension services, farmers and policy makers to ensure agroecological principles are demystified and incorporated.

Towards food systems transitions through a regional multi-actor research network for agroecology in East Africa (RMRN-EA)

Frank Chidawanyika, John Adriko, Kizito Kwena, Abdullah Mkiga, Richard Onwonga, Japhet Kashaigili, Anthony Eguru, Thomas Dubois

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13 January 2026, TSARA Science Days, Online

Introduction

- Diverse farming typologies of mixed crop and livestock systems
- Heavily reliant on rain -fed agriculture
- Highly vulnerable to climate variability and climate shocks
- Low productivity due to poor soil fertility and biodiversity loss
- Strong need for agroecological approaches to support food system transitions
- Existent research and knowledge gaps,
- Incorporation of indigenous knowledge systems
- Building enabling policy environment

Introduction



Mobilisation and engagement of different stakeholders



Build excellence in research and education



Providing leadership in research and knowledge co-creation

Regional multiactor research networks on agroecology

West Africa: CORAF

East Africa: *icipe*

Kenya, Tanzania and Uganda



Africa: FARA

Southern Africa: CCARDESA

objectives

1. strengthen STI **capacities** of RMRN related to agroecology principles (data, gender)
2. increase the RMRN's contribution to **scientific knowledge** generation and innovation for agroecology
3. enhance the RMRN **support** on agroecology to practitioners, scientists policy -makers

www.icipe.org

Overall goal of RMRN-EA



Building sustainable agri-food system transition based on agroecological principles and practices in sub-Saharan Africa





RMRN-EA beneficiaries and target groups



Specific objective 1

Goal	Approach
To develop curricula in agroecology	• Assess the gaps and needs in existing agroecology courses/curricula • Cater for the needs of the region and the entire innovation pathway • Responsive to market needs and contemporary challenges in agroecology

MAKERERE UNIVERSITY

University of Nairobi

icipe
The TROpical Insect Science Institute

Specific objective 1


Industry professionals' questionnaire for developing a regional MSc in Agroecology curriculum –University of Nairobi, Makerere University, and Sokoine University of Agriculture


Policymakers and regulatory bodies' questionnaire for developing a regional MSc in Agroecology curriculum –University of Nairobi, Makerere University, and Sokoine University of Agriculture


Survey on training needs for short course/summer school in Agroecology


Farmers and community representatives' questionnaire for developing a regional MSc in Agroecology curriculum – University of Nairobi, Makerere University, and Sokoine University of Agriculture


Faculty members' questionnaire for developing a regional MSc in Agroecology curriculum –University of Nairobi, Makerere University, and Sokoine University of Agriculture


Current and prospective students' questionnaire for developing a regional MSc in Agroecology curriculum –University of Nairobi, Makerere University, and Sokoine University of Agriculture


Alumni questionnaire for developing a regional MSc in Agroecology curriculum –University of Nairobi, Makerere University, and Sokoine University of Agriculture

- Needs assessments for curricula currently under way in the 3 countries targeting various stakeholders using the above tools
- Validation workshops to follow in the first quarter of 2026

www.icipe.org

MAKERERE UNIVERSITY

University of Nairobi

icipe
The TROpical Insect Science Institute

Specific objective 2

Goal	Approach
To strengthen the capacities of NARS to produce, collect, access, process and share data/information	• Assessing capacity needs among national research partners (universities, NARS) • Linking databases that support agroecology • Scientific and technical training • Knowledge management and exchange hubs

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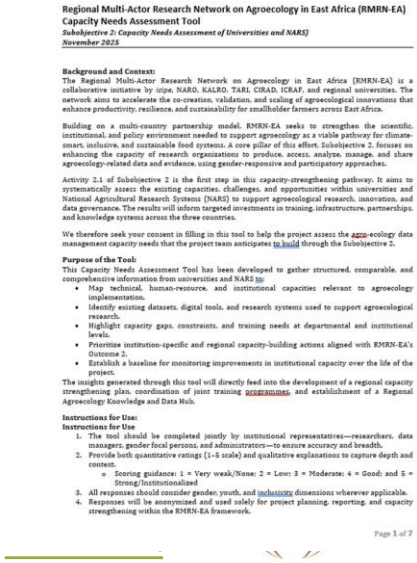
Specific objective 2



Regional Multi-Actor Research Network on Agroecology in East Africa (RMRN-EA)
Capacity Needs Assessment Tool
Subobjective 2: Capacity Needs Assessment of Universities and NARS)
November 2025

Background and Context:
The Regional Multi-Actor Research Network on Agroecology in East Africa (RMRN-EA) is a collaborative initiative by icipe, NARO, KALRO, TARI, CIRAD, ICRAF, and regional universities. The network aims to accelerate the co-creation, validation, and scaling of agroecological innovations that enhance productivity, resilience, and sustainability for smallholder farmers across East Africa.

Building on a multi-country partnership model, RMRN-EA seeks to strengthen the scientific, institutional, and policy environment needed to support agroecology as a viable pathway for climate-smart, inclusive, and sustainable food systems. A core pillar of this effort, Subobjective 2, focuses on enhancing the capacity of research organizations to produce, access, analyze, manage, and share agroecology-related data and evidence, using gender-responsive and participatory approaches.

Activity 2.1 of Subobjective 2 is the first step in this capacity-strengthening pathway. It aims to systematically assess the existing capacities, challenges, and opportunities within universities and National Agricultural Research Systems (NARS) to support agroecological research, innovation, and data governance. The results will inform targeted investments in training, infrastructure, partnerships, and knowledge systems across the three countries.

We therefore seek your consent in filling in this tool to help the project assess the agro-ecology data management capacity needs that the project team anticipates to build through the Subobjective 2.

Purpose of the Tool:
This Capacity Needs Assessment Tool has been developed to gather structured, comparable, and comprehensive information from universities and NARS to:

- Map technical, human-resource, and institutional capacities relevant to agroecology implementation.
- Identify existing datasets, digital tools, and research systems used to support agroecological research.
- Highlight capacity gaps, constraints, and training needs at departmental and institutional levels.
- Prioritize institution-specific and regional capacity-building actions aligned with RMRN-EA's Outcome 2.
- Establish a baseline for monitoring improvements in institutional capacity over the life of the project.

The insights generated through this tool will directly feed into the development of a regional capacity strengthening plan, coordination of joint training programmes, and establishment of a Regional Agroecology Knowledge and Data Hub.

Instructions for Use:
Instructions for Use
1. The tool should be completed jointly by institutional representatives—researchers, data managers, gender focal persons, and administrators—to ensure accuracy and breadth.
2. Provide both quantitative ratings (1–5 scale) and qualitative explanations to capture depth and context.
   - Scoring guidance: 1 = Very weak/None; 2 = Low; 3 = Moderate; 4 = Good; and 5 = Strong/Institutionalized
3. All responses should consider gender, youth, and inclusivity dimensions wherever applicable.
4. Responses will be anonymized and used solely for project planning, reporting, and capacity strengthening within the RMRN-EA framework.

Page 1 of 7

- Capacity Needs Assessment Tool developed together with Universities and NARS partners
- Assessments currently underway in the 3 countries
- Validation workshops will be conducted in February 2026 followed by tailored technical training covering areas such as agroecology assessment tools, data management and sharing

Specific objective 3

Goal	Approach
Participatory validation and scaling of agroecological innovations at different scales	• Contextualized agroecological innovation bundles • Co-design principals through 'living labs' • Assess socio-economic, cultural and gender-related benefits, drivers and bottlenecks • Knowledge gaps and research-M.sc. & PhD involvement

Specific objective 3

Kenya



Kiambu (*Cshap LL*)

- Main challenges:Cereal & vegetable pests, & low soil fertility
- Possible innovations: Biopesticides, PPT, parasitoids, frass fertiliser



Machakos (*Greenshade LL*)

- Main challenges: Water scarcity, vegetable pests, & low soil fertility, soil degradation
- Possible innovations: Biopesticides, PPT, parasitoids, frass fertilizer, water harvesting



Embu LL

- Main challenges: Water scarcity, Tree pests & diseases
- Possible innovations: Biopesticides, parasitoids, water harvesting

Specific objective 3

Uganda



Mt Elgon LL

- Main challenges: land degradation, & low soil fertility, crop pests, limited fodder
- Possible innovations: Biopesticides, PPT, parasitoids, frass fertiliser



Kamuli LL

- Main challenges: pests and diseases in a coffee agroforestry system, Possible innovations: Biopesticides, PPT, parasitoids,



West Nile LL

- Main challenges: Low soil fertility, pests & diseases, limited fodder
- Possible innovations: Biopesticides, parasitoids, PPT, frass fertiliser

Specific objective 3

Tanzania



Nyakabindi LL

- **Main challenges**: pests in cotton & vegetable system with high pesticide use limited fodder
- **Possible innovations**: Biopesticides, PPT, parasitoids,



Julius Nyerere LL

- **Main challenges**: Horticulture hub with pests and high pesticide, **Possible innovations**: Biopesticides, PPT, parasitoids,



Seatondale Hub

- **Main challenges**: Horticulture hub with orchard and vegetable, pests & diseases
- **Possible innovations**: Biopesticides, parasitoids,

Specific objective 4



- NARS
- Ministries of Agriculture
- Regional bodies
- Farmer bodies
- International Research Centers

November 2025

Overall project outcomes & impact



2 policy recommendations

www.icipe.org

Agroecology and sustainable farming in Africa

Cédric Gaucherel

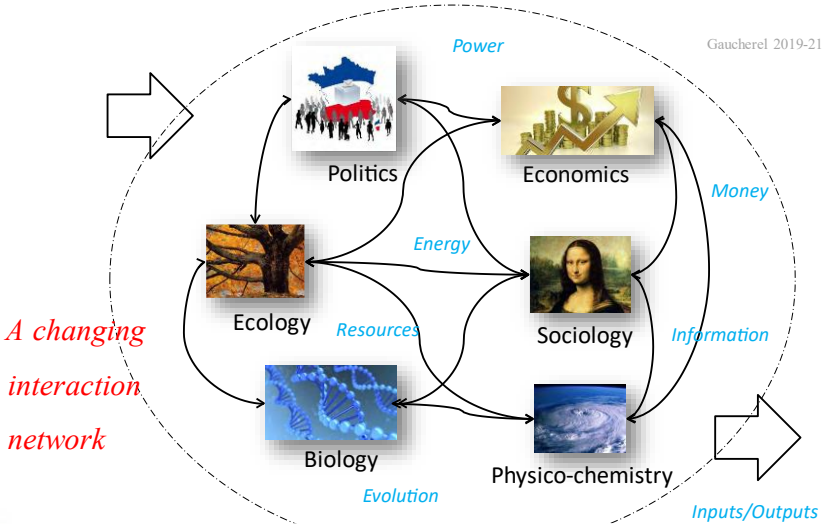
INRAE, UMR AMAP, France

Food security is an issue and a challenge in many African countries. For reaching such a sustainable target, agroecology and diversified productions seem to be relevant directions, while still difficult to design in arid and semi-arid areas. For this purpose, modelling at farm scale is a way to exploring the various ways for reaching the wanted system state and dynamics. This was our main objective in the SESASA European project lead by the orator on this topic, in Burkina Faso and Ghana. In particular, qualitative and possibilistic models, such as the ones developed under the EDEN (Ecological Discrete Event Network) framework, appear to be innovative and

well adapted in that they allow grasping all possible futures of the modeled farm (as soon as a faithful model is assumed). This talk will explain the principle of our original possibilistic models and then illustrate it on the specific case of an agropastoral farm of southern Burkina Faso. This approach is dedicated to almost any social-ecological system and has the potential to provide recommendations in most related contexts and stakes.



What is a social-ecological system?



EDEN: qualitative possibilistic models

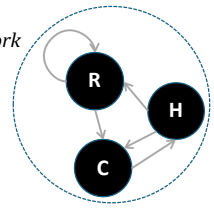


Which outcome(s) and dynamics?



+ = ?

The *Ecosystem interaction Network*

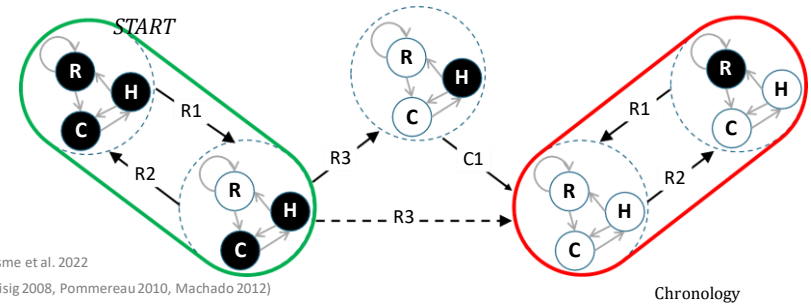


Rule:	Conditions → Realizations	Descriptions (qualitative + discrete-event)
R1:	R+ → R-	Shift in dry season
R2:	R- → R+	Shift in rainy (R) season
R3:	R- → C-	Dry season may destroy crop fields (C)
R4:	R+, H+ → C+	Humans (H) plant crop fields (and feed on them)
C1:	C- → H-	Humans depend on crops (or die or move)

Simplification and **formalization** of a social-ecological system, to compute its responses to strong perturbations

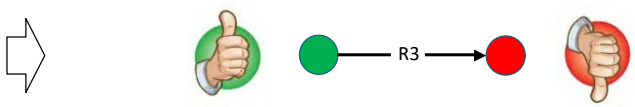
Concurrent stabilities/dynamics

The corresponding *state-space* and merged state space



Gaucherelet al. 2019, Cosme et al. 2022

Discrete-event models (Reisig 2008, Pommereau 2010, Machado 2012)



Such agro-ecosystems may be stable **AND** instable.

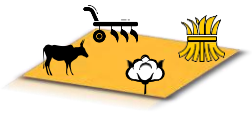
A realistic social-ecological system

Southwestern Burkina Faso





Cosme et al. 2022



A poor farm (type **A1**)

*<u>How</u> can a poor farm (A1) develop a **sustainable agropastoralism** ?*

+ Through which events? *+ In which scenarios?*

TARGET

Diversified knowledge feeds the model

VARIABLES

(14 Variables & 44 Rules)

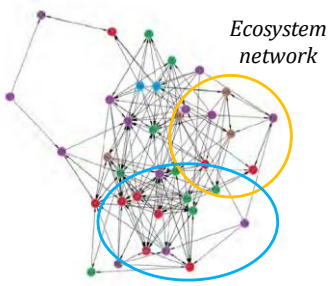
```
state_variables:
  Cr-: Crop residues
  Lv*: Livestock
  Ma-: Manure
  Cc-: Cash Crops #
  Fp-: Fodder Crops
  Fe*: Soil fertility#
  Eq-: Equipments
  Ca-: cropped area

control_variables:
  EC*: Erosion control
  Flw*: Fallowing
  Rg*: Rangeland
  CRC*: Crop residue collection
  Nf*: Non-farm activities
  Fg*: Free grazing allowed
```

```
constraints:
Cr- >> Fp-
Eq- >> Cc-, Ca-
Lv- >> Cc-, Ca-
Fe- >> Cc-, Ca-
Rg-, Flw-, Fp- >> Lv-, Ma-, Eq-, Ca-
CRC-, Fg-, Fp- >> Lv-, Ma-, Eq-, Ca-
Cr-, Fg-, Fp- >> Lv-, Ma-, Eq-, Ca-
```

CONSTRAINTS (priority rules)

RULES

```
rules:
Fe+ >> Cr+
Ma+, Eq+ >> Cr+
Cc+, Flw-, Rg+, Cr+, Eq+, CRC+ >> Lv+
Nf+, Flw-, Rg+, Cr+, Eq+, CRC+ >> Lv+
Cc+, Flw+, Cr+, Eq+, CRC+ >> Lv+
Nf+, Flw+, Cr+, Eq+, CRC+ >> Lv+
Cc+, Flw-, Rg+, Fg+ >> Lv+
Nf+, Flw-, Rg+, Fg+ >> Lv+
Cc+, Flw+, Fg+ >> Lv+
Nf+, Flw
Cc+, Fp
Nf+, Fp
Lv+, Rg+, Cr+, Eq+, CRC+ >> Ma+
Lv+, Rg+, Fg+ >> Ma+
Lv+, Flw+, Cr+, Eq+, CRC+ >> Ma+
Lv+, Flw+, Fg+ >> Ma+
Lv+, Fp+ >> Ma+
Lv+, Cr+, Eq+ >> Cc+, #
Eq+, Flw-, Cr+ >> Fp+
Eq+, Lv+, Fe+, Cr+ >> Cc+
Flw+ >> Fe+
EC+, Fg-, Eq+, Cr+, CRC- >> Fe+
EC+, Eq+, Ma+ >> Fe+
Flw-, EC- >> Fe-
Flw-, Cr-, Ma- >> Fe-
Flw-, Eq+, CRC+, Ma- >> Fe-
Flw-, Fg+, Ma- >> Fe-
Flw-, Eq- >> Fe-
Cc+, Lv+, Cr+ >> Eq+
Nf+, Lv+, Cr+ >> Eq+
Lv+, Cr+ >> Eq+
```



Ecosystem network

- A <u>scenario</u> = a combination of control variables

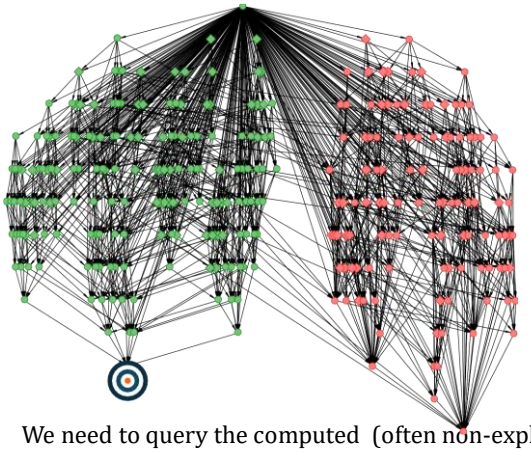
Example: Fg⁺, EC⁻, Flw⁺, Nf⁻, CRC⁻, Rg⁺

- 6 control variables , $2^6 = 64$ scenarios

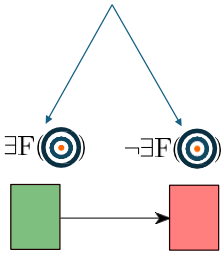
The computed state space and Queries

A large state-transition graph

(1444 states, 2578 transitions)

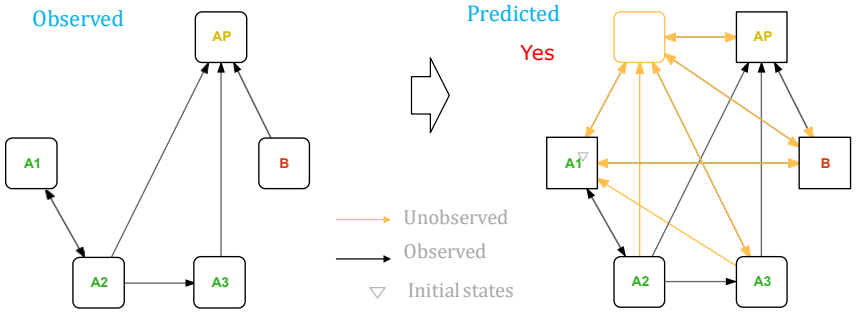


Computation **T**ree **L**ogic **(CTL)**



We need to query the computed (often non-explicit) state-transition space

Q3. A “validated” model

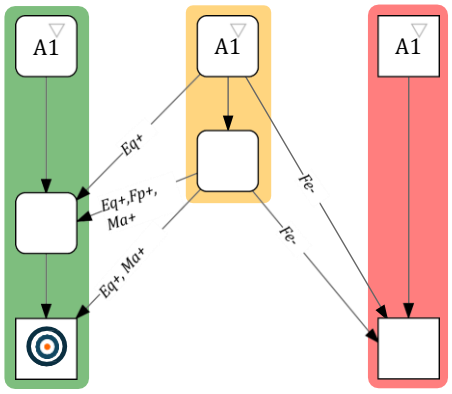


Ouédraogo et al. 2016

Observed farm trajectories	Corresponding CTL formulae	Predicted
A1 → A2 → A3 → AP	$A1 \wedge \exists(A1\ U\ (AA \wedge \exists(AA\ U\ (AA \wedge \exists(AA\ U\ AP)))))$	Yes
A1 → A2 → A3	$A1 \wedge \exists(A1\ U\ (AA \wedge \exists(AA\ U\ AA)))$	Yes
A1 → A2 → AP	$A1 \wedge \exists(A1\ U\ (AA \wedge \exists(AA\ U\ AP)))$	Yes
A2 → A1	$AA \wedge \exists(AA\ U\ A1)$	Yes
B → AP	$B \wedge \exists(B\ U\ AP)$	Yes

Through which processes/management?

Through which transitions?



In which scenario(s)?

- **Fallowing** *AND*
- (Fodder and livestock) *OR* (Non-farm activities)

- **Erosion control and no fallowing** *AND*
- (Fodder and livestock) *OR* (Non-farm activities)

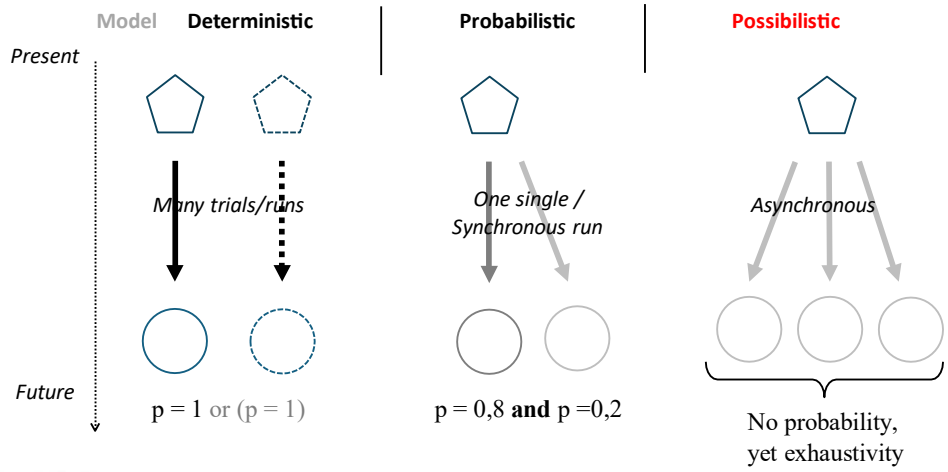
Cosme et al. 2022

Q3. Finally, to develop a sustainable agropastoralism, we need:

i. Erosion control + Fodder (Vall et al., 2008; Moulin et al., 2021)

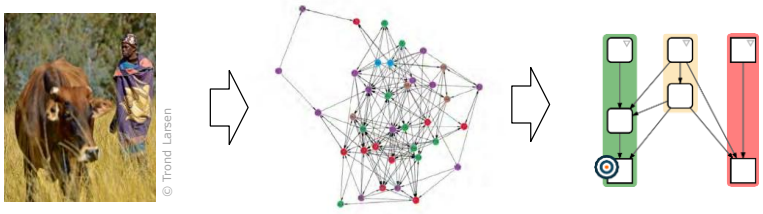
ii. Income (Barrett et al., 2001) + iii Manure + iv Equipment (Local knowledge)

Possibilism framework



Conclusions

- Social-Ecological systems are highly **heterogeneous**,
- They require **possibilistic** methods (EDEN) for …
- efficiently **integrating** (indigenous/scientific) knowledge,



- And … ultimately finding our place in them.

The SIMPA seminar: a South–North dialogue on participatory approaches in wetlands

Calypso Beauchamp

INRAE, France

Wetlands, semi-natural environments shaped by human activities, provide essential ecosystem services (hydrological regulation, carbon storage, biodiversity, etc.). Their preservation requires rethinking governance methods and collective water management by mobilizing all relevant stakeholders. In this context, the INRAE experimental unit of Saint-Laurent-de-la-Prée is coordinating the MAVI project (Maintaining Living Marshes in the Face of Climate Change), which aims to co-design, together with local stakeholders, sustainable strategies for water management and agropastoral practices that reconcile production, adaptation, and conservation.

To foster dialogue and share participatory research experiences in wetlands, an international seminar will be held in December 2025, bringing together researchers from France, Morocco, Uganda, and Tunisia. The case studies presented concern: the Atlantic marshes of Poitou (France), the merjas of Gharb (Morocco), a wetland restoration program (Uganda), participatory management of water resources in the Sidi Bouzid region (Tunisia), and an artificial wet buffer zone in Brie (France). The event will combine scientific presentations, field visits, and participatory workshops with local stakeholders. Graphic facilitation will be used as a tool for analysis and collective knowledge sharing. The communication will focus on the drivers and obstacles to agroecological transition identified in the wetlands involved, as well as a comparison of the existing participatory approaches.



1st Science days
January NN 2026

Farruggia Anne
Mzali Lilia
Choukrani Hajar
Beauchamp Calypso

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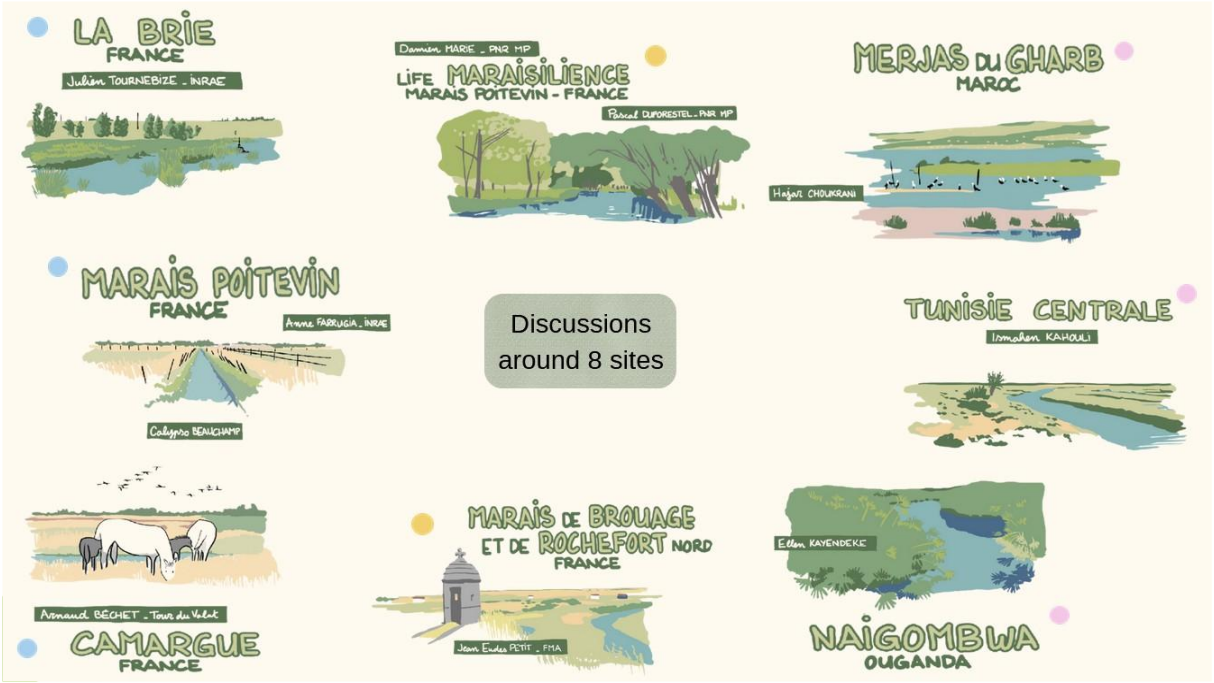




Workshop between local partners and researchers

Workshop between researchers from North and South

How does a collective come together?

The central role of facilitation
Facilitator who listen and remain neutral

↓

Convergence is based first and foremost on posture

Clear, known, and shared rules

↓

Without an explicit framework, participation generates mistrust.

A relationship of trust built over time with the stakeholders

↓

Elected representatives, avoid state services to maintain a climate of trust

Feasibility conditions, realistic objectives, available resources

↓

Participation within a defined operational framework

How to organize the timeline for the process?

Clarify the project. Identify the stakeholders. Define the common objectives.

↓

The consultation process is being prepared even before it begins.

A flexible schedule: Allow time between workshops, but not too much. Be open to adjustments.

↓

A participatory approach cannot be static.

Who is leading this initiative?
Who is mobilizing?
What confidence in the carrier

↓

Without perceived legitimacy, participation does not work.

Take into account the political time frame

↓

The political context can have an impact on participatory processes.

Lessons and perspectives for research

Transparance →

No hidden agendas

Each person's role is clearly defined since the beginning

"maîtrise d'usage"

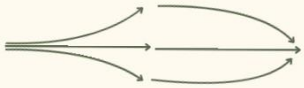
Relational →

Resource persons

Preliminary diagnosis

Neutrality in animation

Divergent



Convergent

An analytical study employing a comparative framework is presently under development. →

Présentation/Sites	Contexte ZH	Objectif général du projet de R ou du Part.	Pilote de la démarche = Tiers de confiance	Acteurs	Finalité scientifique	Finalité opérationnelle	Actions de recherche ou autre	Leviers + importants	Problèmes identifiés	Points communs avec d'autres sites
RECHERCHE France Camargue : Tour du Valat	Marais alluviaux avec agriculture intensive (riz, maraichage intensif) sur sol salé et hot spot de biodiversité	Accompagner les agri. camarguais : chercher le cercle vertueux agri/biodiv	INRAE puis Coopérative Rizosel	W avec 10 agri AB pour éviter les conflits et etre dans le positif	Typologie des bords de champs et rôle de hdv	Restauration des IAE avec ateliers de travail pour contraintes et leviers	Identification de la biodiversité dans les bords de champs (protocole)	1.Objectif très ciblé 2.Approche agronomique pour intéresser les agriculteurs	1.Animation territoriale : temps, personnes, disponibilité des acteurs ; tiers de confiance très occupé : EH 2. menaces : agri de firme, ra moléculles pesticides et riz	Céréaliculture intensive/drainage Pilotage par instance locale - la Recherche documente par des suivis - travail expérimentale avec groupe d'éleveurs
RECHERCHE France Marais poitevin : Commune de Champagné Sud	Marais desséchés littoraux et gestion de l'eau dans un secteur de céréaliculture intensive drainée	Gestion des niveaux d'eau entre les usages en préservant la fonctionnalité des ZU	Etat : établissement Public du marais poitevin (EPMP)	Tous les acteurs : céréaliers, éleveurs, habit, pecheur, chasseurs, naturalistes, Fédérations, écluiers, syndicat de marais	Tester une démarche avec objectif de résultat échelle Territoire	Construire un contrat de marais plus concerté	Entretiens puis ateliers de co-conception	1.Pas de pilotage par la Recherche 2.Approche agronomique pour intéresser les agriculteurs		Céréaliculture intensive/drainage Pilotage par instance locale - Etat - partage de la biodiversité « hostile » - Accompagner que être lieder
RECHERCHE Ouganda : Naigombwa wetlands	ZH avec papyrus vs. terres drainées avec du riz	Identifier des stratégies d'intervention pour préserver ces zones de papyrus	Recherche validée ensuite par la communauté locale	Les habitants, sur des terres appartenant au gouvernement	Identifier les services rendus par les zones avec papyrus	Concilier sécurité économique et alimentaire et services ecosystémiques de la zone	Enquêtes et scénarios			Céréaliculture intensive (riz)/drainage Etat Scenarios

Studying the sustainability of vegetable farming through a viability theory framework.

Isabelle Alvarez – INRAE
Sophie Martin – INRAE
Xiaotang Sun – INRAE
François Lavallée – ISC-PIF
Etienne Delay – CIRAD
Raphaël Duboz – CIRAD
Rakya Ogueye – Cheikh Anta Diop University (UCAD)

This presentation highlights one of the ongoing achievements of the TSARA Valium project, which combines companion modelling and mathematical viability theory to provide local stakeholders with a better understanding of the sustainability challenges related to their activities.
The presentation details the methodological steps implemented to support vegetable growers in the Niayes region of Senegal, who are facing water resource constraints and, occasionally, issues related to local overproduction.
The Valium project has benefited from the experience of CIRAD and GRET within local water platforms, as well as from previous research based on companion modelling. These contributions supported the development of the "f'eau Diem" role-playing game (Niayes 2040 project, funded by AFD), its implementation, and the first field experiments (within the Programme Convention on Commons, funded by GRET and AFD).
Building on these activities and on experiments conducted with vegetable growers using the game (with the participation of F. Lavallée), a translation of the game into a viability problem was developed. The objective was to modify the game dynamics and rules as little as possible while developing a complete modelling process.
The first step consisted of studying the viability problem for a single player managing a single plot. This involved selecting the variables subject to viability constraints, which must be respected at all times (the farmer's capital and the groundwater table level), and reproducing the mechanisms of the game by translating the player's possible actions (choice of crop production on the plot, irrigation method, well digging, acquisition of irrigation equipment) and the evolution of the variables over time. Even in this highly simplified case, it was shown that not all possible states are viable.
The second step focused on defining the viability problem for multiple players. For a given player, the actions of the other players are considered as disturbances, leading to a guaranteed viability problem. The objective is to identify the states and actions for which this player can remain viable regardless of the actions taken by the others. The computation of this guaranteed viability kernel was implemented using the ViabLab library. The guaranteed viability kernels of each player must be non-empty for the collective viability problem to be successfully solved.
Further work on this topic will involve examining, together with stakeholders, the commitment and control mechanisms that could be introduced when the game has no solution. Commitments help reduce uncertainty, thereby increasing the size of the guaranteed viability kernels of the other players.
Within the timeframe of the project, a proposal was submitted and accepted under the PEPR Maths-Vives programme. Indeed, the proposed approach, based on multi-agent viability theory, can be generalised and extended to other resource-sharing problems.

Sustainability of market gardening: a multi-agent viability study

Isabelle Alvarez (INRAE), Sophie Martin (INRAE), Xiaotang Sun (INRAE), François Lavallée (ISC-PIF), Etienne Delay (Cirad), Rakya Ogueye (UCAD), Raphaël Duboz (Cirad)

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January 13 2026

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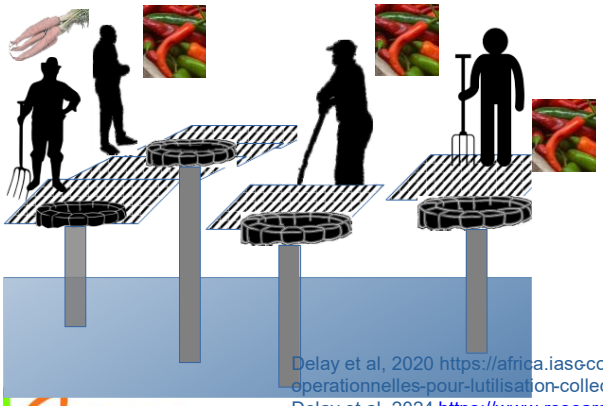
VALIuM : Viabilité, Accompagnement,modéLisation, sImulation, Multi-agent

The issue of market gardening in the Niayes area

- Decline of water resource
- Episodes of local overproduction





Delay et al, 2020 https://africa.iasc-commons.org/video_presentation/de-lexercice-de-prospective-aux-regles-operationnelles-pour-lutilisation-collective-des-ressources-en-eau-le-cas-des-niayes-au-senegal-fr/
Delay et al, 2024 https://www.researchgate.net/publication/357770114_NIAYES_2040_Rapport_final

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Formalizing the dynamics of the serious game



- A game turn corresponds to one year (2 seasons)
- Players choose in turn :
  - their crops
  - their irrigation method
  - *to deepen their well and at what depth*
  - *to acquire additional irrigation systems*
- At the end of the game turn:
  - Players receive their gain (sales less costs)
  - simulation of groundwater recharge

Jeu f'eau Diem : https://www.youtube.com/watch?v=O6EgBLjaPvA

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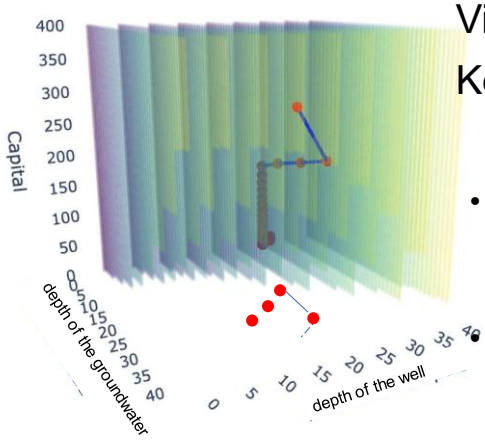
Defining a viability problem



Viability theory:

Keeping dynamics in a constraint set

- In the viability kernel, it is always possible to find controls to stay in the constraint set
- Outside the viability kernel, the dynamics is doomed to exit the constraint set in finite time whatever the controls

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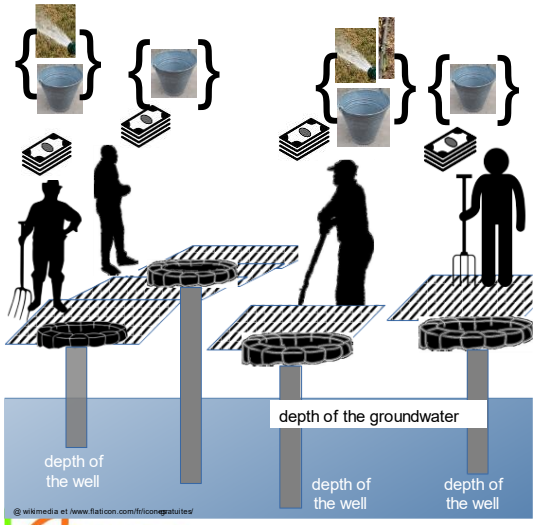
VALIuM : Viabilité, Accompagnement,modéLisation, sImulation, Multi-agent

Defining a viability problem



Identification of variables and constraints from the game

- Individual variables
  - Capital *always above a threshold (0)*
  - Depth of the well *always above a threshold (40)*
  - Irrigation equipment
- Collective variable
  - Depth of the groundwater table *always above a threshold (40)*

Identification of controls (mean of action)

- same as the game

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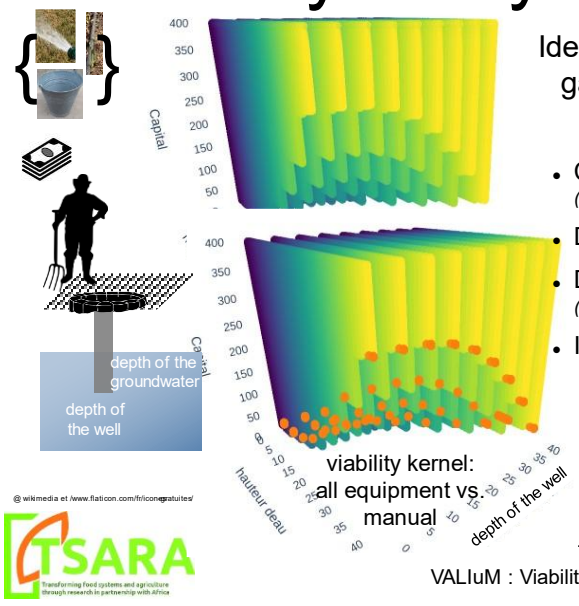
Viability study of a single player



viability kernel:
all equipment vs.
manual

Identification of variables and constraints from the game

- Capital *always above a threshold (0)*
- Depth of the well *always above a threshold (40)*
- Depth of the groundwater table *always above a threshold (40)*
- Irrigation equipment

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VALIuM : Viabilité, Accompagnement,modéLisation, sImulation, Multi-agent

Definition of the multi-agent viability problem



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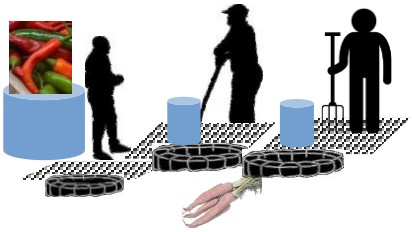

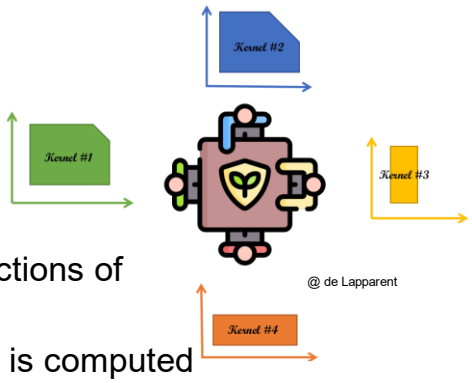

@ de Lapparent

- Each player considers the actions of others as perturbations
- A guaranteed viability kernel is computed for each player
- Each player must have a non-empty kernel for some viable states of the environment

@ wikimedia et /www.flaticon.com/fr/iconesgratuites/

Martin, Alvarez & Lavallée. 2024

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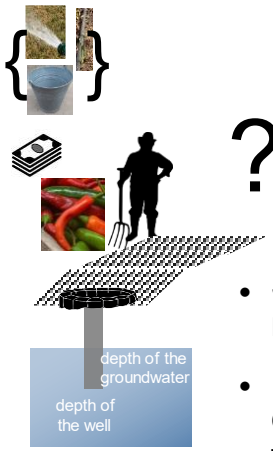
Scheduled and future work



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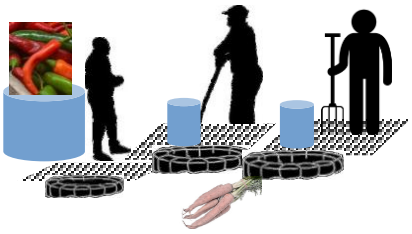

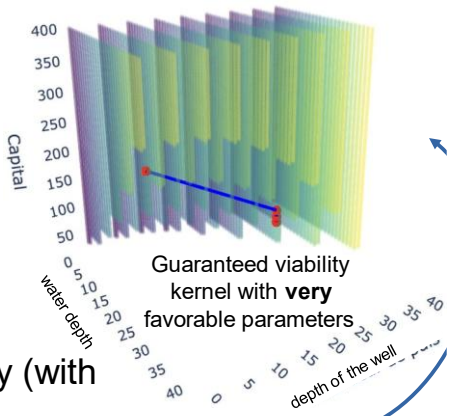

Guaranteed viability kernel with **very** favorable parameters

- Study of the multi-agent viability (with reasonable parameters)
- Integration of collected rules as commitments in the multi-agent viabilty framework



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ALVAREZ Isabelle isabelle.alvarez[AT]inrae.fr
VALIuM : Viabilité, Accompagnement,modéLisation, sImulation, Multi-agent

Governance of the agroecological transition in Burkina Faso

Der Dabiré

CIRDES, Burkina Faso

In Burkina Faso, the government is working to promote agroecology within the dairy value chain, with the aim of ensuring sufficient quantities of high-quality dairy products at affordable prices for consumers. The transition to agroecology in the dairy value chain requires the engagement of various stakeholders, including agropastoralists, collectors, processors, distributors, and consumers. Initiatives supporting this transition have been developed by both public institutions and the private sector, including NGOs and associations, to assist actors in the dairy sector in adopting agroecological practices.

Our study was conducted in this context with the objective of taking stock of institutional initiatives at both national and local levels in the field of agroecology, and assessing their applicability to the dairy value chain in Bobo-Dioulasso. To this end, we employed a socio-anthropological approach based on semi-structured interviews, drawing on a mapping of institutions and organizations involved in supporting agroecology and/or the dairy sector in Bobo-Dioulasso (Sib et al., 2023).

The results show that a wide range of agroecological actions are led by public services, local authorities, professional organizations, research institutes and universities, vocational training centers, NGOs, consulting firms, private agricultural input companies, financial services, as well as other agroecology initiatives in Burkina Faso. These initiatives aim to support agricultural stakeholders in increasing production and improving food security. They include capacity building, technical and financial support, provision of equipment, and more.

However, these initiatives are not all specific to, nor fully adapted to the needs of actors in the dairy value chain, as they are often targeted at one or several categories of stakeholders at a time, with varying levels of intervention. Despite the diversity of efforts, the needs and expectations of dairy value chain actors are rarely fully met by local agroecology initiatives.

To better address these needs and expectations, the agroecological Living Landscape approach represents a relevant entry point. It enables a diverse set of stakeholders within food systems and territorial landscapes to exchange perspectives and knowledge, and to co-develop different types of agroecological innovations.

TSARA SCIENCE DAYS
Webinaire 1: agro-ecological transition




Titre: Governance of the agro-ecological transition in Burkina Faso: a critical assessment of public policies for the agro-ecological transition in the dairy sector in Bobo-Dioulasso



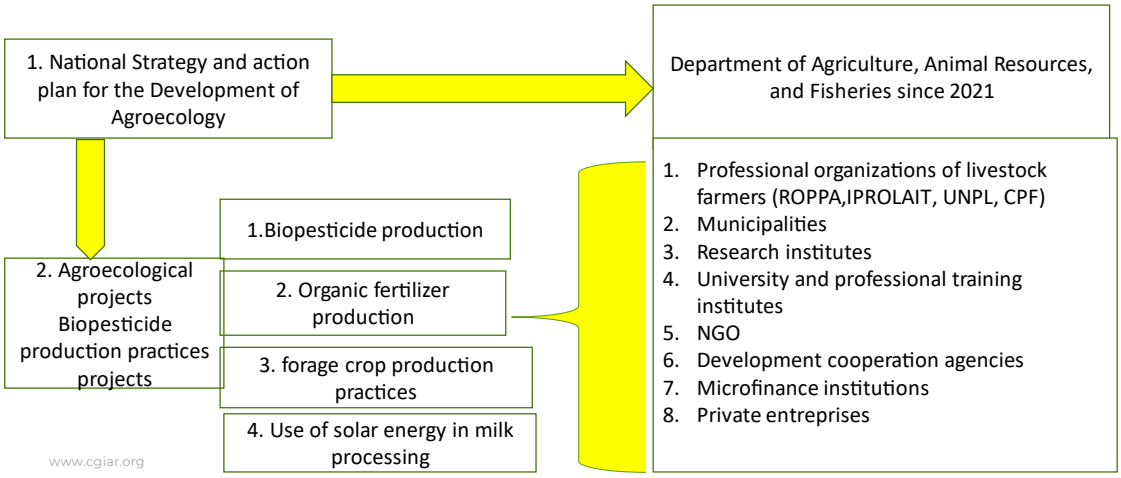
Der DABIRE (CIRDES), Issouf TRAORE(INERA), Ollo SIB (CIRAD)

Plan

1. Types of initiatives and actors
2. Challenges and prospects

1. Types of initiatives and actors

Two types of public policies exist in the field



2. Challenges and prospects

1. challenges

- ❑ Public policies that are neither specific nor tailored to the needs of stakeholders in the dairy sector,

- ❑ Poor coverage of the needs and expectations of stakeholders in the dairy sector

2. Prospects

- ❑ Implementation of the Living Landscape agroecological approach involving all stakeholders (e.g., producers, collectors, processors, consumers, and support and research institutions) in the food system and territories to exchange their views and knowledge, and to co-develop and adapt various types of agroecological innovations based on production of organic fertilizer in covered pits, fodder crops, and the use of natural flavors in local milk processing.

- ❑ Need for financial support to scale up co-constructed agroecological innovations

- ❑ Need for financial support to set up a natural flavor manufacturing unit to support local milk processing.

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Mitigation Practices for low-carbon Livestock in Sub-Saharan Africa (A Living Lab Approach)

Tobi Akinropo

INRAE, France

Livestock production is a critical sector in sub-Saharan Africa (SSA) agriculture, contributing to food security, livelihood, and socio-cultural stability. Despite its importance, assessment of greenhouse gases (GHG), e.g., methane (CH4) emissions from the livestock production system, is limited and fragmented. Previous studies often ignore the diversity of production systems, influenced by agro-climatic zones and management practices. Also, the limitation of a centralized data system impedes the development of scientific-based strategies to improve livestock productivity while mitigating GHG emissions and enhancing farm systems' resilience. To address these challenges, the project "Mitigation Practices for low-carbon livestock production in sub-Saharan Africa Network (MIPCLAN) was developed to promote research-based and indigenous knowledge of GHG mitigation through a living lab approach in the SSA's livestock production systems.

The MIPCLAN built on the outcomes from the previous project on Methods to evaluate low-carbon livestock production in sub-Saharan Africa-Research Network (MeCLAN), where a web-based platform was developed to document the experimental resources/facilities available within contributing institutions in SSA. The platform also aimed to aggregate and centralize data relating to enteric CH4 emissions, animal performance and dietary characteristics. The web platform is linked to the "MeTheix" database that contains published experimental data from studies worldwide. A meta-analysis was conducted on data from livestock systems in SSA from MeTheix, identifying 21 publications (84 treatment means) including 13 on cattle, 5 on sheep, and 3 on goats. This information formed the basis of a participatory workshop on living lab, held in Nigeria.

Findings showed that increased percentage of concentrate, lipid, tannins and saponins supplementation are effective dietary strategies for low carbon livestock in SSA. Challenges identified were limited institutional support, inadequate GHG quantification facilities, over dependence on donor funding, and research-implementation gap. Participants highlighted co-developing innovations/interventions, involving all stakeholders, that fit local contexts, promote knowledge sharing and encourage adoption. Consequently, this led to the development of a document on the operational framework which was proposed as a template for developing Living Labs on livestock systems in SSA. Also, the workshop proposed a "Triple Win" approach in livestock systems, which focuses on improving resilience, boosting productivity, and reducing greenhouse gas emissions.

In conclusion, the project creates a user-friendly and interactive platform that links research communities and institutions across sub-Saharan Africa. It addresses existing knowledge gaps, strengthens collaborative research networks, and supports the co-development of mitigation strategies that achieve the "triple win" objectives. Ultimately, this initiative contributes to the development of evidence-based policies and sustainable, climate-smart pathways for livestock systems in SSA.

Mitigation Practices for lowcarbon Livestock in SubSaharan Africa (A Living Lab Approach)

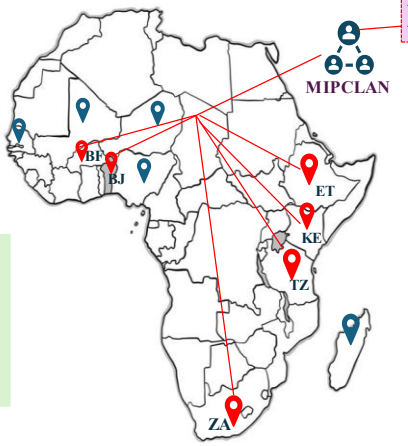
- ✓ INRAE, France
- ✓ CIRAD
- ✓ Luke, Finland
- ✓ IFAD

2023-2025

Establishment of living lab through a network of researchers and stakeholders on GHG emissions from livestock production systems in SSA

GHG

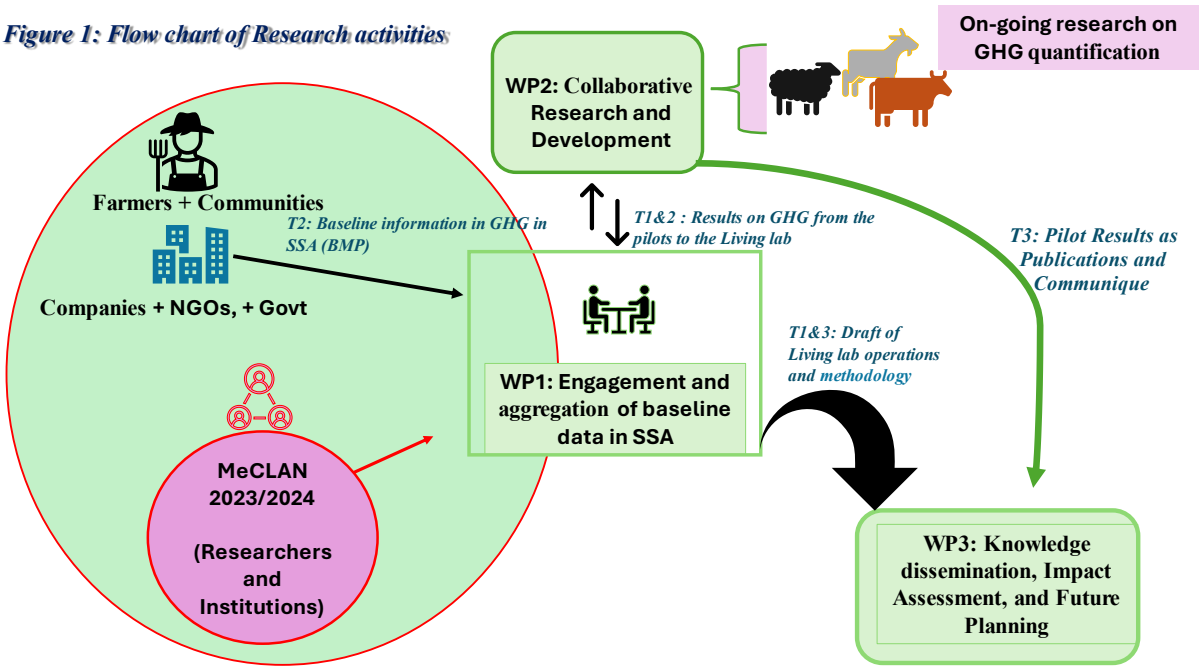
Objective: To promote research-based and indigenous knowledge of GHG mitigation through a participatory approach in SSA's livestock production systems



1st Science days
January 13, 2026

Akinropo Tobi tobi.akinropo@inrae.fr; maguy.eugene@inrae.fr, habibou.assouma@cirad.fr

Figure 1: Flow chart of Research activities





Some outputs

Continuous technical support for partners

- ✓ Training of personnels (Young researchers)
- ✓ Lab visits
- ✓ SOP exchanges

Database creation & data analysis

- ✓ Development of tier 3 for SSA
- ✓ Context specific EF (*including the effect of agro-climatic zones, diets breed and production systems in SSA*)

Knowledge sharing & collaboration

- ✓ Monthly webinar
- ✓ Continuous use of the multi-actor approach in a Living lab
- ✓ Development of operational framework of LL on triple-win livestock case study

Project development & sustainability

- ✓ Funding acquisition for project sustainability
- ✓ Validation of identified context-specific mitigation strategies using locally available feed resources in SSA

Our partners

Maguy Eugene; Diego Morgavi; Cecile Martin; Tobi Akinropo; Audrey N'gom; Carine Marine-Magdeleine-Chevry; Jean-Christophe Bambou; Audrey Fanchone

Habibou ASSOUMA

Ali. R. Bayat

Taye ABEGUNDE
John. A. ODEDIRE
Abimbola AKINKUNMI
Catherine Adefolahan

Abubeker Hassan
Allen Matabane

Luc. H. Dossa
Xavier Gbenou

Alassan Assani Seidou
Josias-Steve Adjassin

Claudia Ardnt
Daniel Mulat
Collins Odour

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Mitigation Practices for low-carbon Livestock in Sub-Saharan Africa (A Living Lab Approach)

Establishment of a Euro-African network on the reuse of treated wastewater

Jérôme Harmand

INRAE, France

The reuse of treated wastewater (REUSE, in its broadest sense, including treated wastewater, greywater, recovered water, desalinated water, etc.) represents a potential lever to address water availability and food security challenges in Africa. However, its implementation must be approached with caution due to the health, environmental, and social risks associated with the use of recycled water resources. It is therefore essential to rigorously assess existing practices and to co-develop strategies with all stakeholders (public authorities, researchers, farmers, industry actors, and civil society) in order to avoid promoting "false good ideas" and to ensure solutions that are appropriate, acceptable, and equitable.

This paper presents the strategy for establishing and scaling up an African network focused on REUSE in Africa, based on three complementary pillars:

- National REUSE Network (INRAE, France): sharing scientific expertise on water quality and its suitability for different uses, monitoring methods, and health risk management tools;
- European COST Action Water4Reuse: facilitating scientific and technical exchanges, harmonizing best practices, and promoting social acceptance of reuse at the European level;
- UNESCO Chair on Water, Waste and Energy (Tunisia): supporting African pilot projects and strengthening local capacities through technology and knowledge transfer, as well as engagement with society.

The paper highlights the need for an integrated, multi-stakeholder approach to build a robust and secure African ecosystem around REUSE, capable of testing, evaluating, and adapting practices to local contexts. It also addresses perspectives for strengthening the network, training, and scientific cooperation to support a transition toward sustainable, equitable, and safe water management. In particular, it emphasizes the importance of working within interdisciplinary networks and embedding water research, in its broadest sense, within the water–matter–energy nexus. Drawing on experience gained in establishing the Tunisian UNESCO Chair on Water, Waste and Energy, the African REUSE network project includes the creation of a "twin" chair in Morocco at Cadi Ayyad University, to be led by Loubna EL FELS.

REUSE4AFRICA - Establishment of a Euro-African network on the reuse of treated wastewater

REUSE4AFRICA - Montage d'un réseau euro-africain sur la réutilisation des eaux usées traitées

HARMAND Jérôme jerome.harmand@inrae.fr
REUSE4Africa

Why a Euro-Mediterranean REUSE Network?

=> from isolated projects to systemic impact

- Water scarcity and climate stress strongly affect Mediterranean and African regions
- Wastewater reuse is a key lever for water security, agriculture and circular economy
- Strong scientific knowledge exists but remains fragmented
- Need for a structured, long-term cooperation framework

The network aims to connect research, training and innovation communities

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REUSE4Africa

Scientific Scope of the REUSE Network

=> Core Scientific Pillars of the Network

- Three scientific pillars:
  - Nature-based and low-energy treatment solutions;
  - Risk assessment, quality and safety of treated wastewaters, microbial and environmental processes in treatment systems;
  - Resource recovery (nutrients, energy, organic matter).

- Two transversal pillars:
  - System modelling and decision-support tools, optimization of REUSE chains;
  - Regulatory frameworks, social acceptance and governance of reuse, territorial and climate resilient water strategies.

The network will promote an integrated and interdisciplinary approach to REUSE.

Structuring the Network: Actors and Synergies

=> Structuring a Euro-Mediterranean Community on REUSE

- Core scientific and structuring poles

Water4Reuse

Funded by the European Union

UNESCO CHAIR

- TSARA project with a triple objective
  - Develop and insert activities within the actual UNESCO chair EDE
  - Future joint-twin Chair in Marrakech
  - A network seen as an African extension of the Water4Reuse CA

- Strong involvement of:
  - University of Montpellier (notably through the ICIREWARD UNNESCO center)
  - INRAE, CIRAD, IRD…

The network will rely on existing structures to ensure credibility and sustainability.

Parallel session B - Practices (practices, tools, technologies, process)

Eco-Climatic Feedbacks of Ethiopia's Green Legacy initiative: a Deep Learning Analysis of Coffee Forests in Maji, Southwestern Ethiopia

Ambaye Kebeba

Addis Abeba University, Ethiopia

This research investigates the eco-climatic feedbacks of vegetation restoration in coffee-forest landscape Maji, Southwestern Ethiopia, emphasizing important role restoring forest and agroforestry in advancing agro-ecological transitions. Utilizing multi-sensor remote sensing, including Sentinel both optical and radar data spanning 2000–2025, vegetation dynamics were quantified, while deep learning techniques were applied to detect subtle changes in forest cover and coffee agroforestry through modelling feedback loops between vegetation gain, soil moisture, and local temperature moderation. The methods used in this research; integrated biophysical indicators such as NDVI, forest canopy density, and soil moisture coupled with local climatic forcing to evaluate the impacts of vegetation gains on temperature regulation, shifting soil moisture content, and increasing ecosystem resilience to changing climate. Preliminary results of this study indicate an 18% net increase in canopy cover over past 35 years, contributing to enhanced soil moisture retention (+12%), cause average maximum temperatures to be reduced by (−1.2°C) and improved microclimatic fluctuations. These climatic regulations impacted biodiversity positively and make coffee yield resilient, showing the potential of integrated agroforestry practices to support sustainable food systems and climate adaptation measures. Discussion of highlighted key findings greatly contribute to green legacy policy implementation, underscoring the importance of continuing the implementation of forest-friendly policies. Policy implications of this study include promoting incentives for agroforestry expansion, integrating digital platforms to enhance farmer involvement and aligning restoration and Green legacy strategies with climate adaptation goals. This study contributes best methodology for a transferable framework for similar coffee-forest systems in tropical regions. Future research directions will include integrating socio-economic data, modeling future climate scenarios and assessing ecosystem service valuations under alternative coffee-forest management practices. This research recommends local community participation, capacity building and cross-sectoral policy alignment are vital to strengthen sustainable agro-ecological transitions. By bridging remote sensing, machine learning, and landscape ecology, this project provides actionable insights for sustaining coffee-forest landscapes while supporting resilient and productive food systems in Maji, Southwestern Ethiopia.

Eco-Climatic Feedbacks of Ethiopia's Green Legacy initiative: A Deep Learning Analysis of Coffee -Forest Mosaics in Southwestern Ethiopia.

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1. Background and Justification

- Vegetation plays a fundamental role in shaping Earth's climate (Miralles et al., 2024[1])
- Green Legacy Initiative (GLI)
- Coffee–forest mosaics

Climate resilience

- Eco-climatic feedbacks

- Many Studies in Ethiopia link vegetation degradation to increase in LST. However,
  -Insufficient evidence on local climate regulation services
  -Quantitative effect of reforestation on local climatic elements in coffee -forest mosaics remain poorly understood.
  -Limited policy relevant metrics of restoration success.

1. Miralles, D. G., Vilà-Gueraude Arellano, J.,McVicar, T. R., &Mahecha, M. D. (2025). Vegetation–climate feedbacks across scales. Annals of the New York Academy of Sciences, 1544(1), 27-41.

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2. Objectives and research questions

- Analyze temporal relationships between forest recovery and climate variables
- Quantify eco-climatic responses, effect size
- Eco-climatic variation between Forest vs non-forest signals

Questions

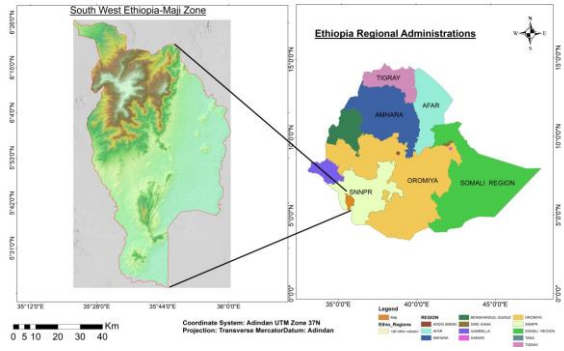
Is there a significant vegetation gain attributable to Green Legacy afforestation?

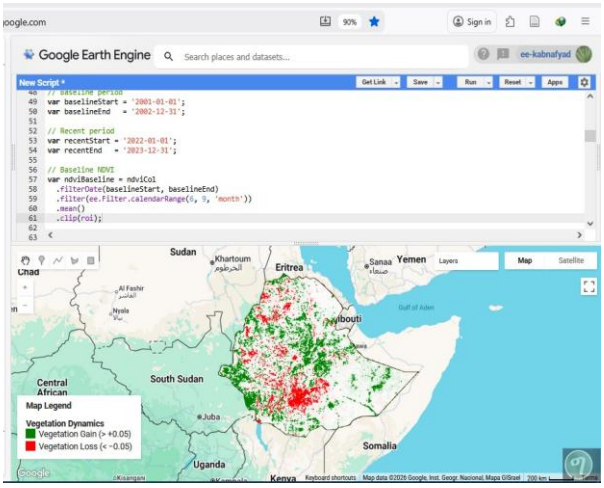
Do GL reforestation create a measurable cooling island and reduce thermal extremes?

Is there significant variations in climatic elements between forested and non -forested areas?

3. Study Area

- Southwestern Ethiopia
- Coffee-forest Agro-ecology
- High biodiversity zone





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4. Data & Methods

- Remote sensing (Terra, MODIS, ERA5, Sentinel)
- Climate Variables

Vegetation attribution

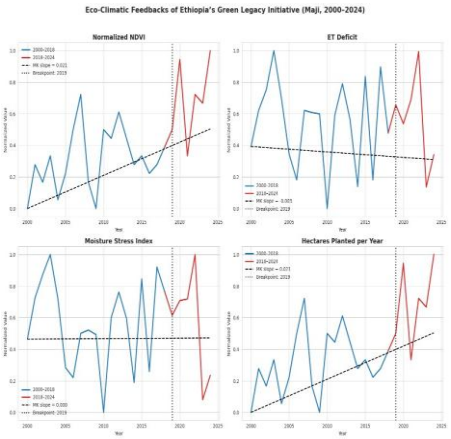
- Mann–Kendall trend + Sen's slope
- Breakpoint detection (pre/post ~2019)
- Counterfactual: nearby non-treated areas

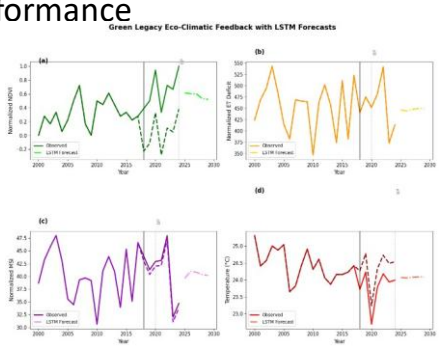
- Regression analysis to measure response strength (Δ Change) of climatic variables against vegetation dynamics

- To analyze the cooling island effect, Forest vs non-forest DiD was employed
- The Quasi-experimental DiD model;
- $Y = \alpha + \beta_1[\text{Baseline Time}] + \beta_2[\text{Intervention}] + \beta_3[\text{Time} * \text{Intervention}] + \beta_4[\text{Covariates}] + \varepsilon$
- $LST_{it} = \alpha + \beta_1 Forest_i + \beta_2 Post2019_t + \beta_3(Forest_i + Post2019_t) + \delta ET_{it} + \theta NDVI_{it} + \cdots + \varepsilon_{it}$

5. Key Results

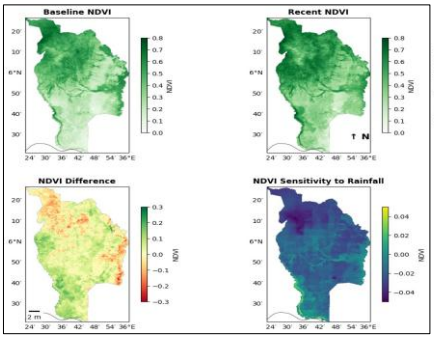
- Eco-Climatic trend detection
- Cooling effect of forests
- Enhanced moisture retention
- Strong DL performance

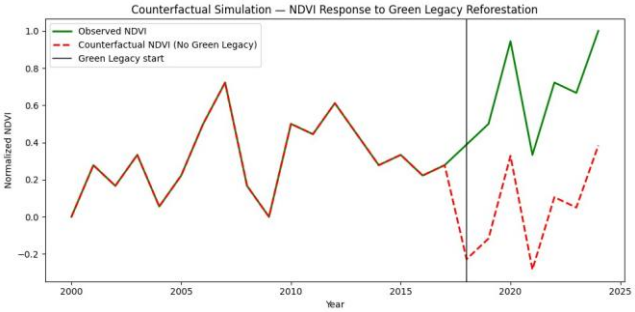




Given the current reforestation continues. LSTM forecast shows

Green legacy has created a measurable biophysical local climate regulation effect.





an

% of forest change in Maji measured by Mean NDVI difference is 7.62% between baseline and recent period.

Thermal buffering

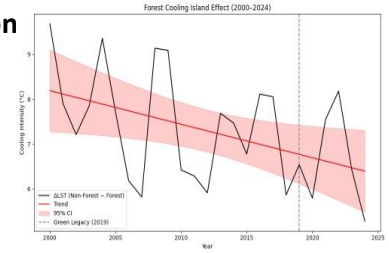
Average temperature range drops from 11 °C in early 2000 to 8.3 °C in 2024.

Cooling is strongest in maximum temperature, not mean

Green legacy has created a measurable biophysical local climate regulation effect.

Dynamic cooling response of LST to green legacy intervention

DID result indicated 0.87 °C Cooling attributed to green Legacy initiatives



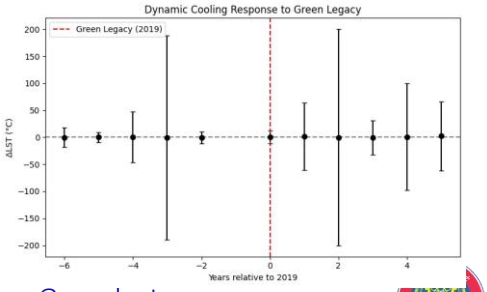
OLS Regression Results

Dep. Variable:	lst	R-squared:	0.879
Model:	OLS	Adj. R-squared:	0.869
Method:	Least Squares	F-statistic:	83.50
Date:	Fri, 02 Jan 2026	Prob (F-statistic):	3.14e-20
Time:	14:19:32	Log-Likelihood:	-86.787
No. Observations:	50	AIC:	183.6
Df Residuals:	45	BIC:	193.1
Df Model:	4		
Covariance Type:	HC3		

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	150.7207	66.994	2.250	0.024	19.415	282.027
treatment	-7.4995	0.431	-17.407	0.000	-8.344	-6.655
post	-1.0956	1.135	-0.965	0.335	-3.321	1.129
treatment:post	0.8732	1.282	0.681	0.496	-1.640	3.386
year	-0.0568	0.033	-1.705	0.088	-0.122	0.009

Omnibus:	1.628	Durbin-Watson:	1.737
Prob(Omnibus):	0.443	Jarque-Bera (JB):	1.269
Skew:	-0.390	Prob(JB):	0.530
Kurtosis:	2.962	Cond. No.	8.34e+05

Notes:
[1] Standard Errors are heteroscedasticity robust (HC3)
[2] The condition number is large, 8.34e+05. This might indicate that there are strong multicollinearity or other numerical problems.



6. Implications

- Agroecological transition
- Climate-smart reforestation
- Increase in coffee yield resilience
- Policy-relevant insights
- Promoting incentives for agroforestry expansion ,
- Integrating digital platforms to enhance farmer involvement and aligning restoration and Green legacy strategies with national climate adaptation goals.

7. Conclusions

- GLI induced forest recovery improved local climatic stability
- Eco-climatic feedback enhance coffee forest agro-ecosystem stability under changing climate
- Improving smallholders resilience thus food security
- Scalable monitoring framework - demonstrates the feasibility of operationalizing eco -climatic feedback monitoring at national scales.

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Beekeeping in support of vegetable farming and biodiversity in Côte d'Ivoire

Koyo Nzala Remiche Ivalda

Kamila Canale Tabet

Cirad, INRAE, France

The AfricanBees project, initiated by Kamila Canale Tabet and funded by TSARA, has led to a PhD thesis co-supervised by CIRAD and INRAE in partnership with INP-HB Yamoussoukro. This work will be presented in the context of the TSARA Sciences Days.

Beekeeping is now emerging as an innovative solution within a sustainable approach aimed at improving cropping systems and food security while preserving the environment. In Côte d'Ivoire, the integration of beehives into market gardening systems is experiencing renewed interest. This approach has a dual objective: (i) to enhance crop pollination through the activity of pollinating insects, particularly bees; and (ii) to provide farmers with an additional source of income through honey and other hive products.

This technique is both simple, requires limited investment, and is locally accessible. It demonstrates that it is possible to reconcile economic profitability with environmental sustainability. Pollinators play a critical role in human food systems: their activity improves crop yields and the quality of fruits and vegetables, enhances plant fertility, and strengthens ecosystem resilience. However, pollination efficiency strongly depends on the type of ecosystem and crops, interspecific interactions, and the genetic diversity of pollinators.

This study therefore aims to assess the genetic diversity of honeybees (Apis mellifera), the overall biodiversity of pollinators in vegetable agroecosystems, and farmers' perceptions of this emerging practice. It is framed within an integrated agroecological approach that values nature as both an agricultural input and a production partner. Initial experiments conducted with peri-urban vegetable farmers in Côte d'Ivoire have shown encouraging results, fostering farmers' acceptance and growing institutional interest for wider dissemination.

Despite these promising outcomes, field surveys conducted among 77 farmers who adopted beehives, as well as field observations, reveal a concerning sanitary situation in apiculture. All surveyed apiaries had at least one colony infested by Varroa destructor, suggesting that the parasite is potentially present across all locations. Broader surveys are needed to ensure data representativeness and to better understand the agri-apicultural situation in Côte d'Ivoire. Other stress factors such as wax moth infestation, ants, bushfires, hive theft, vandalism, and excessive pesticide use have also been identified. These pressures increase the risk of colony absconding, thereby negatively affecting hive productivity.

Preliminary results from genetic analyses of honeybees reveal an African genetic background, confirming the richness of the local apicultural heritage. Overall, beekeeping appears as a strategic lever for agroecological transition in Côte d'Ivoire. It enables the reconciliation of agricultural productivity, biodiversity conservation, and human health, while offering farmers sustainable economic opportunities. By placing bees at the heart of agricultural development and food system improvement, the country is paving the way toward a more sustainable agriculture, respectful of natural balances and contributing to the construction of resilient and environmentally harmonious food systems.



Beekeeping for market gardening and biodiversity in Côte d'Ivoire



Ivalda Remiche Koyo Nzala
PhD student 2Y

Co-direction: Thibaud Martin (CIRAD),
Alain Vignal (INRAE)
Co-supervision: Kamila Canale-Tabet (INRAE),
Emilie Deletre (CIRAD),
Rahim Ouedraogo (CIRAD)



1

Entry Point for Agroecological Conversion? Three research axes



Perception and integration of **beekeeping** among vegetable farmers within Agroecological Transition



Impact of agricultural practices on **wild pollinator biodiversity**



Genetic Diversity analysis of *Apis mellifera adansonii*



15

1. Perception and integration of beekeeping among vegetable farmers within Agroecological Transition



What are socio-economic and psychosocial factors that influence beekeeping perception intensity and adoption among market gardeners in Côte d'Ivoire?

Observations

- Limited understanding of technical guidelines
- Overuse driven by the pursuit of rapid results
- Dosage misinterpretation
- Treatment without PPE
- Waste management

Improvement suggestions

- Oral and visual guides to explain phytosanitary notices
- Translation notices into local languages
- Encouraging PPE wearing using local manufacturing solutions







16

2. Impact of agricultural practices on wild pollinator biodiversity



How do agricultural practices influence biodiversity and of wild pollinator communities composition in market gardening plots in Côte d'Ivoire?

Observations

- Limited number of taxonomists
- Lack of species-specific identification keys for sub-Saharan Africa

Improvement suggestions

- Development of molecular identification tools, use AI ?
- Training specialists for species identification for this region
- Securing existing data and developing dedicated databases


RESEARCH ARTICLE | Open Access

Classifying the unknown: Insect identification with deep hierarchical Bayesian learning

Sarkhan Badirli, Christine Johanna Picard, George Mohler, Frannie Richert, Zeynep Akata, Murat Dundar

17

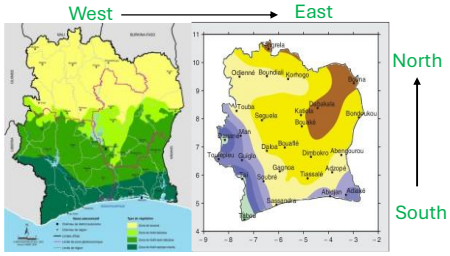
3. Genetic Diversity analysis of *Apis mellifera adansonii*



What is the diversity and genetic background of *Apis mellifera adansonnii* present in Côte d'Ivoire?

Data collection: September 2024-January 2025 → Data production, database → Data analysis (in progress)





64 hives
29 sites
1264 bees
294♂'0 ♀ K = 5





45 bees sequenced, (Whole genome sequencing)

18

3. Genetic Diversity analysis of *Apis mellifera adansonii*



Observations

- Pathogen-related health issues
- Anthropogenic pressures on hives : theft, bushfires, vandalism, and land-use conflicts

Improvement suggestions

- Raising awareness among beekeepers and farmers
- Training people in beekeeping and apiary management

(AACI, UNASCA-CI, FENAPCI)



19

Agroecological management of sheep reproduction in Tunisia: Automated monitoring of sexual activity in the Black Thibar breed using the Ovimate electronic mounting detector

Samia Khnissi

INRAT, Tunisia

Within the framework of the FERTUNIDIV project funded by TSARA, a study was conducted to assess the effectiveness of the Ovimate electronic mounting detector, developed by INRAE (UMR SELMET), on Tunisian local sheep breeds, with the aim of integrating it into the agroecological management of reproduction.

The study was carried out at the experimental station of the OEP (Office de l'Élevage et des Pâturages) and involved 50 ewes equipped with RFID (Radio Frequency Identification) tags and 3 rams of the Black Thibar breed fitted with the Ovimate electronic mounting detector. Estrus in the ewes was induced and synchronized using a 14-day FGA (fluorogestone acetate) sponge treatment, followed by a male effect and mating over two cycles. The onset of estrus was monitored over a 3-day period.

The results showed that the Ovimate detector identified estrus in Black Thibar ewes with an efficiency of 82% (41 out of 50 ewes). Detected ewes entered estrus 56.8 ± 15.3 hours (mean ± standard deviation) after sponge removal, and estrus duration was 9.3 ± 6.4 hours. The lambing rate reached 74% (37 out of 50 ewes), with a prolificacy rate of 137%, which is particularly notable for the Black Thibar breed.

In parallel, the Ovimate device enabled the assessment of ram libido. The monitoring revealed significant differences in sexual behaviour among rams. The three monitored rams performed 205, 100, and 87 mounts respectively over three days. These marked differences highlight the importance of characterising sexual behaviour in order to select and maintain the most active rams, thereby ensuring an effective male effect and improved reproductive performance.

Overall, the study demonstrates that the Ovimate electronic mounting detector is a relevant tool for assessing the sexual behaviour of both ewes and rams in Tunisian local breeds. It can support the development of alternative reproductive management strategies that reduce the use of hormonal treatments for artificial insemination, relying instead on the male effect. These promising results open important perspectives for extending this technology to other local breeds, particularly the Sicilo-Sarde breed, a unique dairy sheep breed in North Africa. This work fully aligns with an agroecological transition approach aimed at strengthening the sustainability of extensive livestock systems in Tunisia by reducing hormonal inputs.

Agroecological management of sheep reproduction in Tunisia: Automated monitoring of sexual activity in the “Noire de Thibar” breed using the Ovimate electronic mounting detector

Presented by : Samia Khnissi
Team: Nathalie Debus, Hela Chalouatti and Stéphane Fabre

Framework

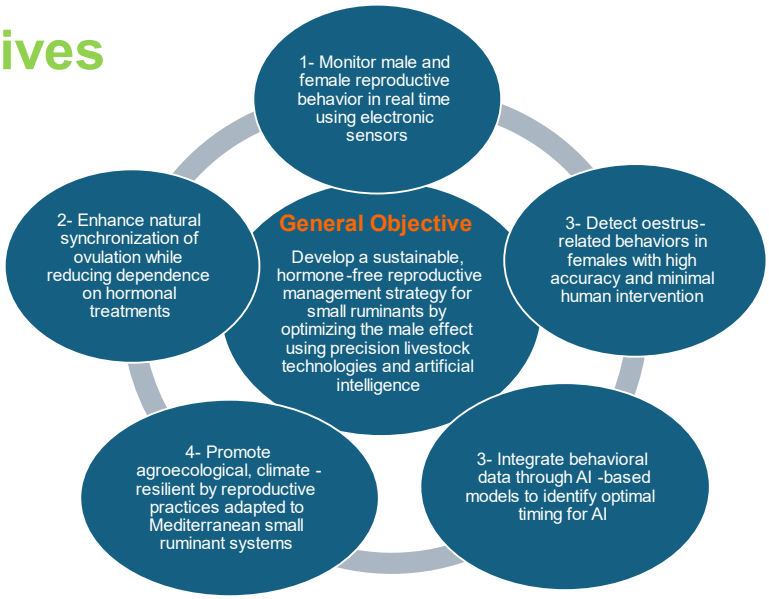


As part of FERTUNIDIV project (Evaluation of genetic diversity and fertility management for the sustainability of small ruminant farming systems in Tunisia) funded by TSARA, studies were conducted to evaluate the effectiveness of the **Ovimate** electronic mounting detector, developed by INRAE (UMR SELMET), on local Tunisian sheep breeds, with the aim of using it in the agroecological management of reproduction.

Issue & Problematics

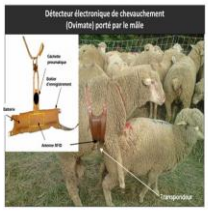
- Sheep and goat farming is a key pillar of food security, rural livelihoods, and cultural heritage in Tunisia and the Mediterranean basin.
- Livestock systems are mainly extensive, low-input, and climate-sensitive, making reproductive efficiency a critical determinant of sustainability and productivity.
- Its efficiency remains highly variable and poorly controlled, due to the lack of precise tools to monitor sexual behavior and optimize male and female interactions.
- In Tunisia, the use of hormonal protocols is not widely accessible to farmers due to their high cost. Their application remains limited to specific breeds, such as the Noire de Thibar and the Sicilo-Sarda, mainly within controlled reproductive programs involving a limited number of artificial inseminations.
- The male effect, a natural and hormone-free mechanism inducing and synchronizing estrus, represents a promising but underutilized strategy under Tunisian production conditions.

Objectives



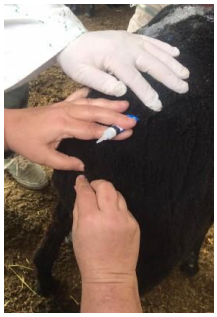
Methodology

- The study was conducted at the experimental station of Office of Livestock and Pasture in Tunisia.
- Fifty “Noire deThibar” ewes were equipped with RFID (Radio Frequency Identification) tags, and three rams were fitted with the Ovimate electronic mounting detector.
- Estrus in ewes was induced and synchronized using FGA intravaginal sponges for 14 days, followed by the male effect and natural mating over at least two reproductive cycles (≈ 40 days).
- The kinetics of estrus onset in ewes were monitored for three days, after sponge removal and ram introduction.



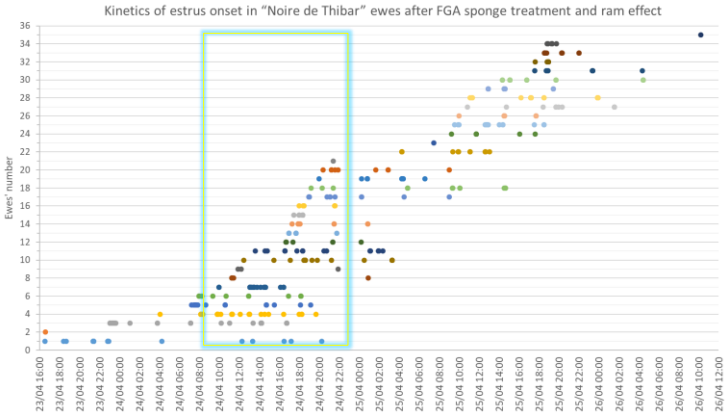






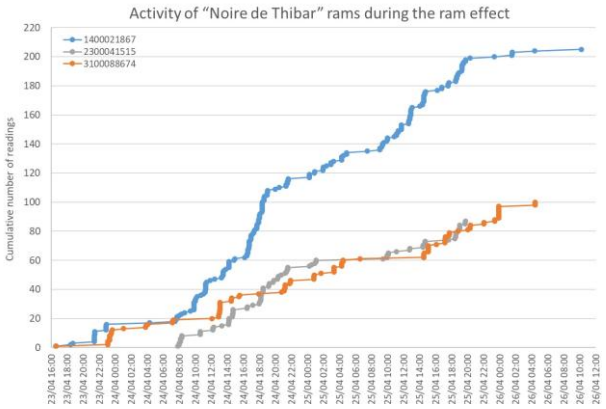


Results



The Ovimate detector detected the estrus of 41 out of 50 ewes (82%). The estrus of the ewes began 56.8±15.3 h after sponge removal and lasted 9.3±6.4 h

Results



The Ovimate detector was able to assess the rams' libido and revealed significant differences between rams (from 87 to 205 readings in 3 days).

Conclusion

- The Ovimate electronic mounting detector is a relevant and effective tool for assessing the sexual behavior of ewes and rams from local Tunisian breeds.
- It can be used in the development of alternative reproductive management strategies that limit the use of hormonal treatments for artificial insemination and are based on the ram effect.
- These first promising results open up important perspectives for extending this technology to other local breeds, particularly theSicilo-Sarde, a unique dairy sheep breed in North Africa (trial ongoing).

These results are fully align with an agroecological transition approach aimed at strengthening the sustainability of extensive livestock systems in Tunisia by reducing hormonal inputs.

Community-based breeding programs as a framework for managing native tropical animal genetic biodiversity: cross-learning between Senegal and Guadeloupe

Younouss Camara

Université Gaston Bergé, Sénégal

Senegal and the French Antilles have animal breeds adapted to humid tropical climates and sharing similar adaptive trajectories. Despite their comparative advantages, linked to their suitability for local production systems, these breeds are often perceived as less productive than exotic breeds selected for their production performance. However, when properly leveraged, these advantages can be competitive and contribute to addressing food security challenges in both the Antilles and Senegal.

To respond to these issues of valorisation of local breeds, recent initiatives have been developed in Senegal through the Sustainable Management of Endemic Ruminant Livestock Project (PROGEBE) and in Guadeloupe through the KariBioKréyol project. These initiatives, co-constructed with livestock keepers, take the form of Community-Based Breeding Programs (CBBP).

The comparative analysis of specific and shared lessons from both CBBP approaches is of triple scientific interest, aimed at generalisation: (i) comparing livestock systems in two humid tropical environments (insular and continental), (ii) analysing the cultural and socio-economic relationships of two societies (Peul and Creole) with their local breeds, and (iii) studying two research ecosystems involved in the implementation process of a CBBP.

These approaches are based on increasing awareness among livestock keepers and other stakeholders of the advantages of local breeds and their contribution to the future of livestock systems. Participatory breeding models foster strengthened interdisciplinary and participatory research, built around joint actions promoting innovations that valorise local products and resources, as well as the development of production systems, particularly in animal health.

However, in Senegal, the cattle breeding program faced challenges related to the satisfaction of multiple objectives of livestock keepers, herd health monitoring, and issues of legitimacy and representativeness of farmers within the cooperative structure. In Guadeloupe, the KariBioKréyol project also engaged with collective imagination (stories about Creole breeds) and traditions (slaughtering under the mango tree, ox-pulling competitions) to co-build a community-based breeding approach around Creole breeds, seeking to reconcile deeply rooted traditional practices of the informal economy with the European framework of the formal economy.

- **Objectives:**



KariBioKréyol

- Pooling knowledge and jointly developing a shared vision of Creole races
- Co-designing research areas and strategies for managing Creole breeds

PROGEBE

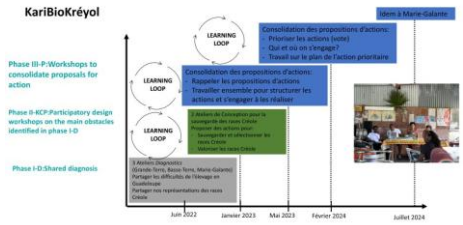
- develop and test an integrated approach to the conservation and sustainable management of Ndama cattle



- **Lessons learnt: the process of implementing a CBBP :**

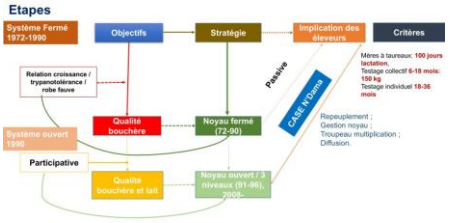
KariBioKréyol

- Mobilisation of management sciences: KCP method (innovative design)



PROGEBE

- Participatory approach: selection cooperative (CASE Ndama)



- **Lessons learnt: the process of implementing a CBBP:**

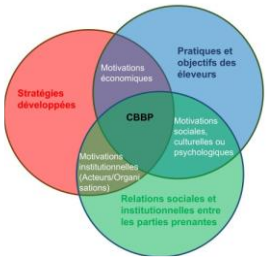
Beneficial aspects…

- Awareness of the advantages of native breeds
- Interdisciplinary research and innovation (Management Sciences, KCP)
- Promotion of traditions and cultures linked to native breeds (stories about Creole breeds, traditional production practices)

… constraints and obstacles

- Difficulties in meeting the multiple and differing objectives of stakeholders
- Issue of subsidies linked to the management of breeds perceived as less productive (status of breeds threatened with abandonment for agriculture recognised in France but not in Senegal)
- Conflict in the management of cooperatives





Rainfall patterns change impacts on agroecological systems in sub-Saharan Africa: the case of maize production and nitrogen use in sub-humid Zimbabwe

Gwenaëlle Lashermes

INRAE, UMR-FARE, France

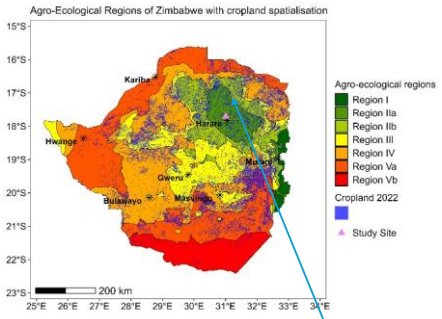
Altered rainfall patterns and extreme events are critical aspects of climate change that threaten agricultural production worldwide. This is particularly true for rainfed maize in Sub-Saharan Africa, the main staple crop and primary food source for local population. Increasingly intense and frequent mid-season dry spells, interspersed with heavy rainfall events, pose a further challenge to already low and stagnant yields. Understanding these impacts is therefore essential to support intensification and adaptation efforts aimed at increasing yields and meeting the growing food demand.

To this end, a rainfall-manipulation field experiment was established in 2022 in sub-humid Zimbabwe through a partnership between INRAE, CIRAD, and the University of Zimbabwe. During the first two seasons (2022–23 and 2023–24), different maize systems were evaluated for their productivity and nitrogen (N) use efficiency under manipulated rainfall conditions, including a 30% reduction in rainfall and simulated heavy rainfall events (100 mm day^{-1}), compared to ambient rainfall. The tested agroecological practices included surface residue application (6 t ha^{-1}) and increased N fertilizer application (80 kg ha^{-1}, split and banded), which is a key intensification lever in the context of smallholder farming in sub-Saharan Africa. An adjacent 15N labelling experiment was also conducted in the second season to trace the fate of fertilizer N in the soil–plant system.

The two experimental seasons were markedly contrasting: the first season was close to normal, while the second was extremely dry and is considered the worst in the region in a century. Among the main findings, the poor rainfall distribution during the second season sharply reduced maize productivity by up to 90 %, despite an annual total close to the long-term average. Intra-seasonal rainfall variability and extreme events explained nearly 78 % of maize yield variability, far outweighing the effects of mulching and N fertilization. Surface crop residues, though applied at the maximum rate allowed by biomass production in these systems, were unable to compensate for the negative impacts of extreme rainfall events on yield and N uptake. Another notable result was that simulated heavy rainfall events doubled yields under N fertilization during the dry season. Overall, N uptake by the crop increased with N fertilizer addition during both cropping seasons, with an apparent recovery rate of 39 % in average under the favourable rainfall conditions of the first season. However, 15N tracer-based measurements of actual N fertilizer use indicated very limited uptake from the various N fertilizer applications during the drought, with only 3–4 % recovered under ambient and reduced rainfall conditions. Under these conditions, the additional moisture provided by the heavy rainfall events significantly increased N recovery to at least 15 %.

The results indicate that projected future fluctuations in intra-seasonal rainfall variability will pose a major challenge to efforts aimed at increasing rainfed maize productivity in sub-Saharan Africa. They also underscore the limitations of relying solely on seasonal cumulative rainfall in crop production impact assessments. The findings further highlight the risks associated with intensification through mineral fertilizers, and the limits of local practices such as surface residue application to buffer rainfall variability adverse effects in the short-term. For effective adaptation, instar-seasonal rainfall patterns and extreme events must be considered alongside agronomic practices when designing resilient crop and nutrient management strategies.

Context



Region considered suitable for intensive farming
Annual rainfall of 750–1000 mm over a single rainy season (November-April)
Maximum temperatures 23-27 °C

Changes in rainfall patterns & extreme events linked to climate change: a threat to global agricultural production.

Particularly true for rainfed maize in Sub-Saharan Africa, the primary food source.

Already low and stagnant yields.

→ Understand these impacts to support agriculture intensification & adaptation efforts aimed at increasing yields.

→ A Study site in sub-humid Zimbabwe

Materials & Methods

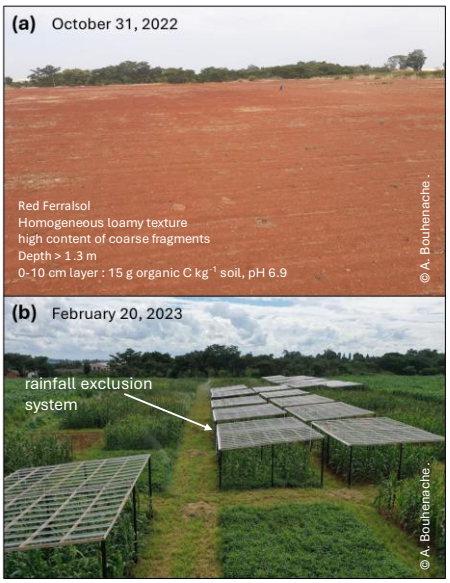
Establishment of a rainfall-manipulation field experiment in 2022 near Harare (partnership INRAE, CIRAD, University of Zimbabwe).

Evaluation of maize cropping systems over the first 2 seasons for their:

- Productivity
- Nitrogen (N) use efficiency

Under manipulated rainfall conditions:

- 30% reduction in rainfall (**RR**)
- Simulated heavy rainfall events (100 mm day^{-1}) (**HR**)
- Ambient rainfall (**AR**)



The experimental site before (a) and after (b) the experiment implementation

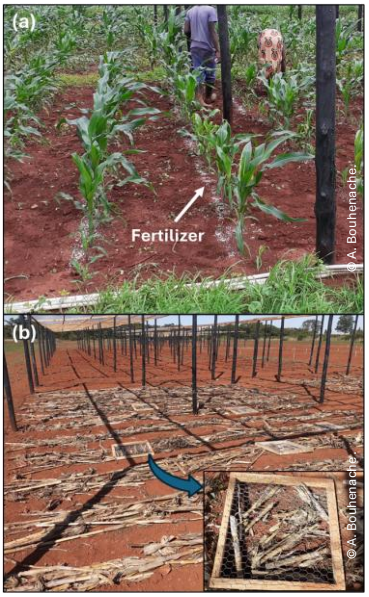
Materials and Methods

Tested agroecological practices :
- fertilizer application (80 kg ha^{-1}, split, banded) (**N80** *vs*, **N0**)

~ a key intensification leverfor smallholder farming in sub-Saharan Africa.

- surface residue application as mulch (6 t ha^{-1}) (**M6** *vs*. **M0**)

+ An adjacent ^{15}N labelling experiment: to trace the fate of fertilizer N in the soil–plant system

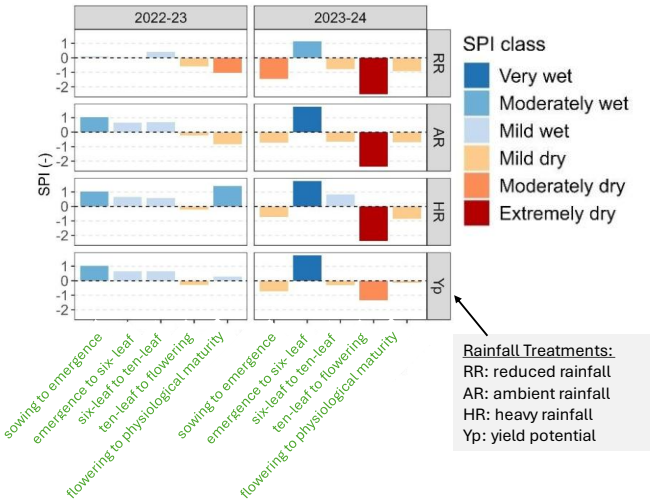


(a) Row N topdressing (January 2023)
(b) crop -residue mulch application (December 2022)

Results: Specific Standardized Precipitation Index (SPI)

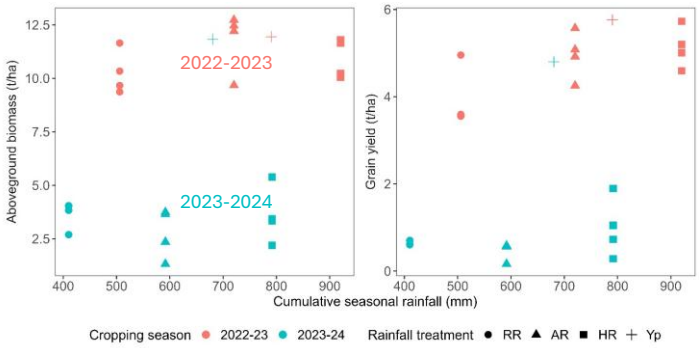
= Rainfall index used to describe intra-seasonal rainfall dynamics (McKee et al., 1993)

2 experimental seasons markedly contrasting:
- A first season close to normal
- A second extremely dry (~ the worst in the region in a century)



Results: maize aboveground biomass & grain yield

Maize productivity response to seasonal cumulative rainfall : a high contrast between the two cropping seasons

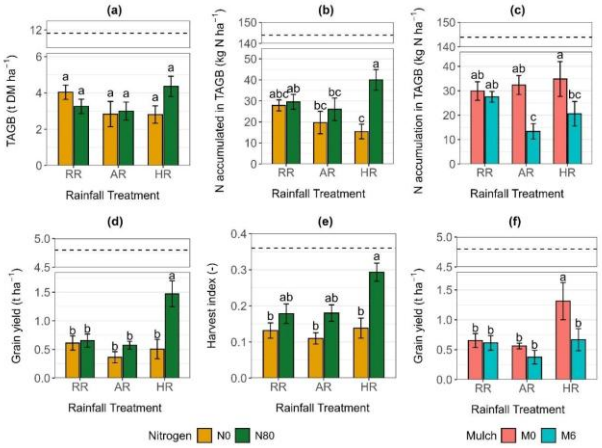


Variations in response for a given cumulative rainfall value is attributed to N fertilization and mulch effects

RR: reduced rainfall; AR: ambient rainfall; HR: heavy rainfall; Yp: yield potential

Results: interactions with N fertilization or mulch

Effect of rainfall treatment interactions with N fertilization or mulch application on maize productivity and N use during the 2023–24 cropping season



Heavy rainfall events doubled yields under N fertilization during the dry season.

Mulches were unable to compensate for the negative impacts of extreme rainfall events on yield and N uptake.

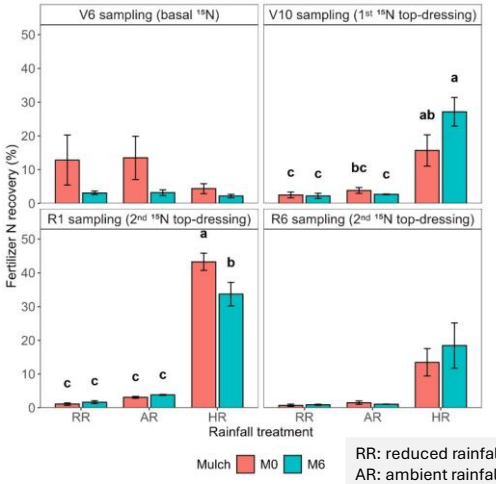
Horizontal dashed lines represent values for the yield potential which was non -replicated.

Results: plant fertilizer N recovery (% ^{15}N applied)

^{15}N tracer-based measurements of actual N fertilizer use (second year) :

- very limited uptake from N fertilizer applications during the drought, under ambient and reduced rainfall conditions.
- the additional moisture provided by the heavy rainfall events increased N recovery

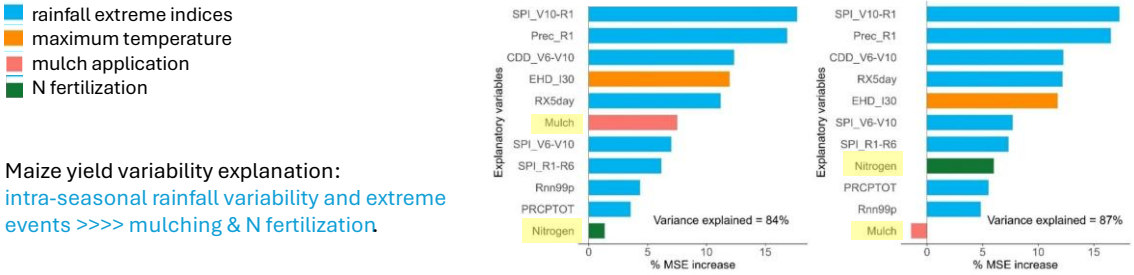
Different maize growth stages



RR: reduced rainfall
AR: ambient rainfall
HR: heavy rainfall

Results: factors affecting maize productivity

Increase in mean squared error (MSE) for variables related to factors



Maize yield variability explanation:
intra-seasonal rainfall variability and extreme events >>>> mulching & N fertilization.

SPI_V10-R1: Standardized precipitation index reflecting dry/wet conditions of V10R1 phase; Prec_R1: Total rainfall within 21-day period centered on flowering; CDD_V6-V10: Maximum number of consecutive dry days (precipitation < 1mm) of V6V10 phase ; EDH-I30: Seasonal extreme hot days intensity as sum of degree days when Tmax > 30 °C ; RX5day: Seasonal maximum consecutive 5-day rainfall; SPI_V6-V10: Standardized precipitation index reflecting dry/wet conditions of V6-V10 phase ; SPI_R1-R6: Standardized precipitation index reflecting dry/wet conditions of R1-R6 phase ; Rnn99p: Seasonal count of days with precipitation > 99th percentile ; PRCPTOT : Seasonal cumulative rainfall on wet days (precipitation ≥ 1 mm)

Conclusions

Poor rainfall distribution during the second season sharply reduced maize productivity by up to 90 %,despite an annual total close to the longterm average :
importance of rainfall patterns >> practices

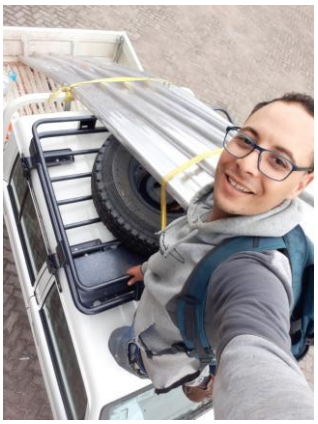
Increase rainfed maize productivity in sub-Saharan Africa:

- challenged by climate projection
- risks associated with intensification through mineral fertilizers, limits of mulch to buffer rainfall variability in the short-term.

For effective adaptation, intra-seasonal rainfall patterns and extreme events must be considered alongside agronomic practices when designing resilient crop and nutrient management strategies.

Maize (left) and sorghum (right) grown on adjacent plots within the same field on clayey soils in (a) Murewa, eastern Zimbabwe, and (b)Mbire, northern Zimbabwe, during the 2023–24 El Niño cropping season.





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Thank you to Abderrahim, & my co-authors

Thank you for your attention !







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- TOTAL Foundation
- IntercropValuES project (https://intercropvalues.eu/) European Union,
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- CLIMAZOTE PhD grant, Université Reims Champagne-Ardenne (URCA)
- University of Zimbabwe

FrEgARCHAEO : the French-Egypt archaeo-logy/genomic Network

Jérôme Salse

INRAE, France

How wheat has been domesticated and cultivated during the last 10,000 years, which traits have been selected, what was the consequence of such domestication syndrome in reducing the currently exploited diversity in farming and how to identify the 'efficient' or even 'lost' diversity to be reintroduced in modern breeding programs in the context of climate change and agroecological transition, remain fundamental opened questions.

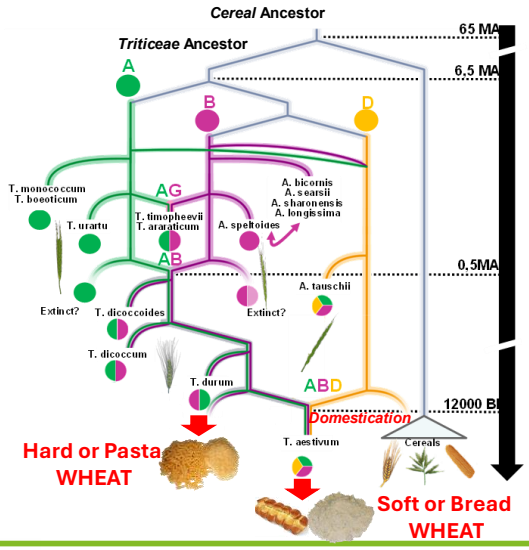
The current collaboration between France and Egypt associates specialists in archaeobotany (investigating past human-plant interactions by studying plant remains in archaeological context) and paleogenomic (investigating ancient DNA) to provide novel insights into the fascinating history of a plant species - wheat - that today is an industry worth a couple of trillion US dollars every year throughout the world and that, since the crucial Neolithic period, has spread with human communities to all continents to become the main cereal crop cultivated worldwide, comprising several thousand recorded modern varieties adapted to a wide range of environments and human uses.

This scientific collaboration relies on the scientific breakthrough proposing a paradigm shift where the development (selection) of wheat varieties adapted to future climate fluctuations cannot rely only on the modern crop (wheat) genetic diversity but requires the identification of the 'hidden' past variability, which may no longer be active in modern elite varieties due to domestication and breeding, but identifiable in ancient remains. This proof of concept has been recently validated by the research group in characterizing, through ancient DNA1, a 5000 years old domesticated wheat intensively cultivated across western Asia and Europe until 1000 BCE (Before the Common or Current Era) that harbors a genetic heritage of deep interest for current breeding schemes (Sow et al. 20252). In complement to classical approaches currently used in agriculture science in characterizing, and exploiting in breeding, traits- or phenotype-driving genes or genetic variants from the present-day genetic diversity, we demonstrated that knowledge of past evolution and adaptation processes from ancient plant DNA can be mobilized to develop varieties adapted to current environmental challenges.

Access to desiccated (grain) material in key to conduct such plant paleogenetic research aiming at reconstructing wheat cultivation (and associated 'lost' genetic diversity) history since its domestication 10 000 years ago. To that regards Egypt is one of the unique countries hosting such materiel at different geological periods spanning the Holocene. Instead of managing (authorization for) material exchanges either difficult or even impossible to obtain for such material considered as a country cultural heritage, we propose to conduct paleogenetic research in the dedicated laboratory at NEMEC (National Museum of Egyptian civilization in Cairo) that we could use for ancient DNA investigation of Egyptian wheat samples. To do so, we propose to settle a five years scientific agreement between INRAE (PaleoLAB from the GDEC unit) and NEMEC from Egypt, such conventioning including research, communication and training activities within the FrEgARCHAEO consortium.

Project-Network FrEgARCHAEO
French-Egypt archaeo-logy/genomic Network

Modern wheats inherited from a complex history



- Progenitors A, B & D (6.5 Mya)
- Hybridizations AG-AB & ABD
- Domestication (10Kya) Plants & Animals
- Cultivated tetraploid (pasta) and hexaploid (bread) wheats

1st Science days
January 13th 2026
SALSE Jerome
FrEgARCHAEO
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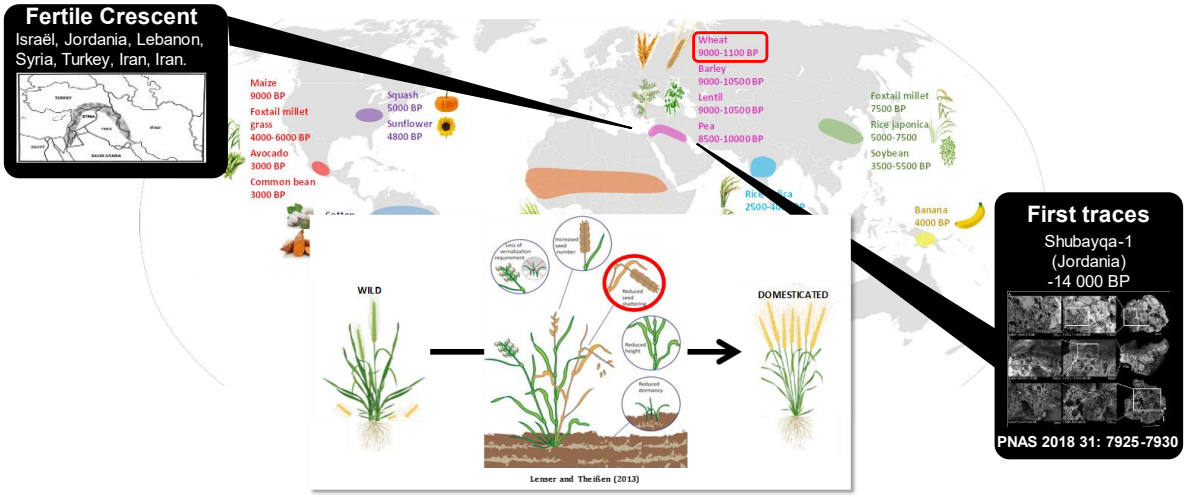
Modern wheats domesticated 10 000 years ago



Plants/Crops domesticated during the last 10 000 years (Holocene) … a part of diversity lost (?) and of interest for modern breeding (?)

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FrEgARCHAEO
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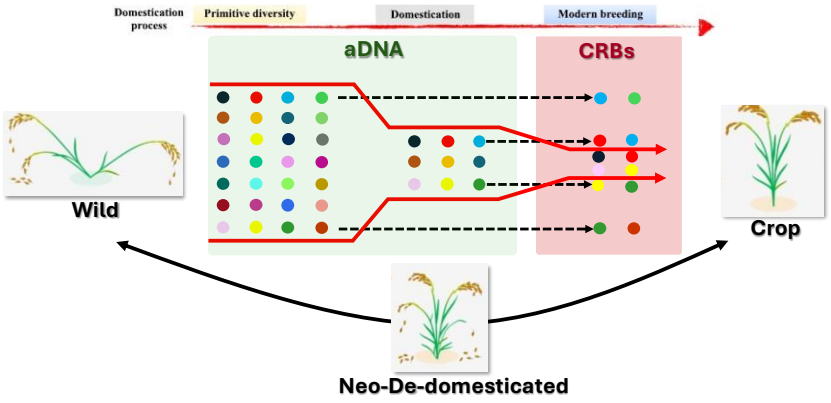
Crop Domestication (semi-domestication, neo-domestication, de-domestication, feralization) for breeding



Modern Challenges in Agriculture (Climate Change & Agroecological Transition) require the use of Past-Wild-Ancient Adaptive Diversity

1st Science days
January 13th 2026
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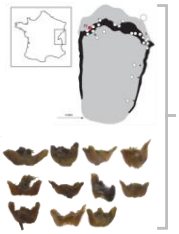
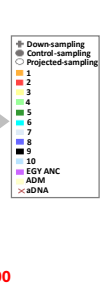
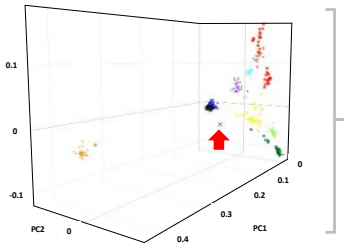
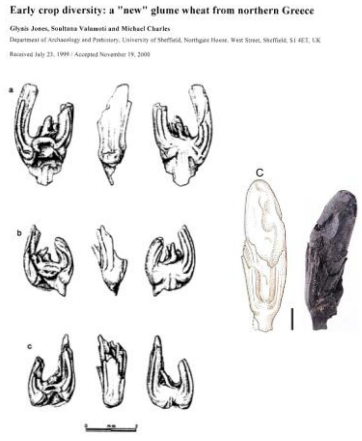
ancient DNA (aDNA) from remains is relevant for modern agriculture



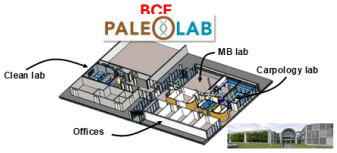






Lake Chalain (France) inhabited from 3,200 to 2,600 BCE

Intermediate to GA (*T. timopheevii* and *T. araraticum*) and BA (DW, DEW and WEW) taxa





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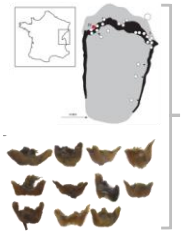

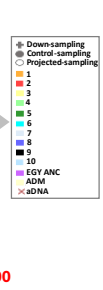

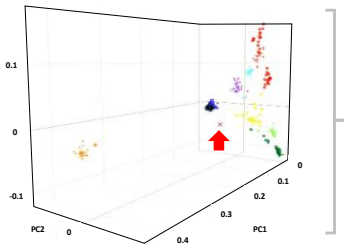

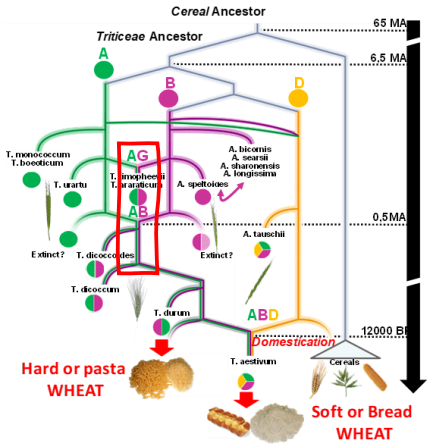

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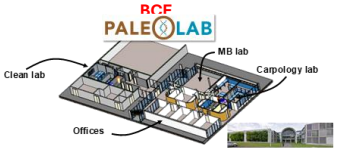



GA wheat type (*T. timopheevii or T. dicoccon*) cultivated in the past in Europe as a source of "new" genetic diversity for modern breeding.

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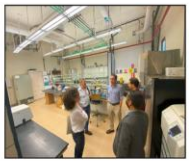
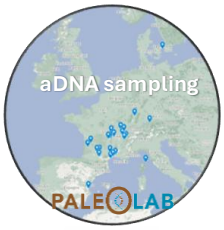
The Project NetworkFrEgARCHAEO, following the TSARA starter project (2023-2024) aims at:

finalizing a partnership conventioning (LPA-like) between the INRAE GDEC Unit with Egyptian collaborators from Cairo

Dr Yehia Z GAG at NMEC (National Museum of Egyptian Civilization)
Dr Mennat-Allah EL DORRY at AUC (American University in Cairo)
[and possibly ministry of culture & science]



to settle a five years scientific project to study ancient wheat remains of thousand years old in using dedicated infrastructure and facilities from Egypt (NMEC), a country offering unique conditions of preservation of desiccated remains (cannot be sent out of the country) ideal for ancient DNA investigation, to reconstruct wheat Agriculture history for future needs.

Project « Starter » TSARA 2023-2024
Demand « soutien réseau » 2026

Local bioresources for the sustainable production of microbial biopesticides: towards an ecological and economic alternative to conventional culture media

Alahou André Gabaze Gadji

INP-HB, Côté d'Ivoire

The intensification of agriculture in Sub-Saharan Africa, and particularly in Côte d'Ivoire, is accompanied by increasing use of chemical pesticides, whose harmful effects on human health, biodiversity, and soils raise significant environmental concerns. In this context, the use of biocontrol agents represents an ecological and sustainable alternative for crop protection.

This study was initiated to valorise agro-industrial waste and crop residues as local bioresources for the sustainable production of *Trichoderma virens*, a biocontrol agent. The objectives were to characterise the physico-chemical profile of agro-industrial by-products and crop residues, and to evaluate the biological performance of *T. virens* strains tested (growth vigour and sporulation).

The results show that the substrates used are rich in organic matter, with contents ranging from 52.77 to 143.22%, except for cashew apple juice (2.69%). They are also more concentrated in calcium and zinc than in magnesium, potassium, manganese, iron, sodium, phosphorus, and copper. Hierarchical cluster analysis allowed the discrimination of three distinct groups of substrates.

Among these, ripe mango pulp, banana peel, maize bran, and cashew apple cake showed good results in terms of growth and sporulation with the R7 strain of *T. virens*. The average growth rate ranged from 11.7 to 14.1 mm/day on these media, with an average concentration of 2×10^6 spores/mL. In contrast, strains E23 and T7 grew well on these substrates but showed lower sporulation ($\leq 10^6$ spores/mL) than strain R7.

No statistically significant difference ($p > 0.05$) was observed between growth rates and spore concentrations obtained on these culture media and the control medium (PDA). These results open promising perspectives for the production of *T. virens*-based biopesticides using locally available substrates.

Transformer les Systèmes Alimentaires et l'Agriculture par une Recherche en Partenariat avec l'Afrique

13, 15, 20 ,22 Janvier 2026

Bioressources locales pour la production durable de biopesticides microbiens: vers une alternative écologique et économique aux milieux de culture conventionnels

GADJI Alahou André Gabaze[1]*, BILE Echua Elisabeth Jasmine[1], TIENEBO Erio-Olivier[2], ABO Kouabenan[1]

[1]Programme Cultures Maraîchères et Protéagineuses du CNRA, Côte d'Ivoire

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INTRODUCTION

La pression accrue des bioagresseurs et les impacts négatifs des pesticides chimiques rendent nécessaire le développement de solutions alternatives durables et accessibles. Bien que prometteurs, les biopesticides microbiens restent limités par le coût élevé des milieux de culture conventionnels importés. La valorisation des bioressources locales (Figure 1), notamment les sous-produits agricoles et agro-industriels, constitue une opportunité stratégique pour produire des substrats nutritifs efficaces et réduire les coûts de production (Bilé *et al.*, 2025).

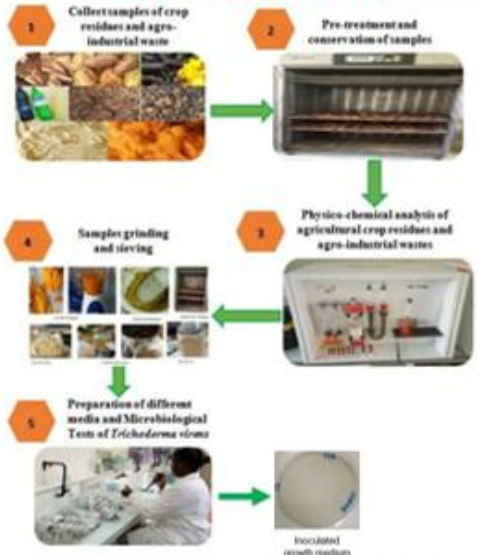


Fig. 1: Produits agricoles

OBJECTIF

Valoriser les rejets agroindustriels et les résidus de récolte comme bioressources locales pour la production durable de *Trichoderma virens*, agent de biocontrôle

APPROCHE MÉTHODOLOGIQUE



RÉSULTATS & DISCUSSION

Hierarchical clustering pf the substrates

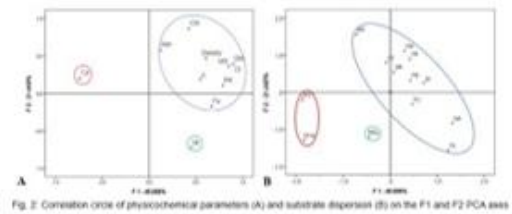


Fig. 2: Correlation circle of physicochemical parameters (A) and substrate dispersion (B) on the F1 and F2 PCA axes

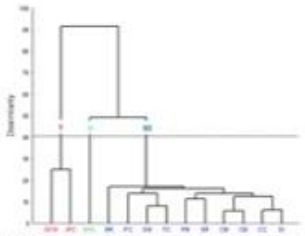


Fig. 3: Hierarchical clustering dendrograms for waste-based substrates

Effect of culture media on the development of *Trichoderma virens* strains

Effect on mycelia aspect

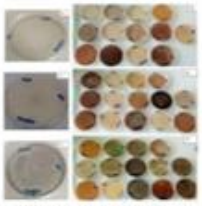


Fig. 4: Macroscopic aspect of Trichoderma virens strains on the tested growth media

Effect on diametral growth and sporulation of T. virens strains

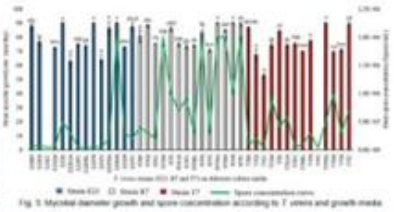


Fig. 5: Mycelial diameter growth and spore concentration according to T. virens and growth media

CONCLUSION

La valorisation des bioressources locales pour la production de biopesticides microbiens offre une alternative écologique et économiquement pertinente aux milieux de culture conventionnels. Cette approche contribue à réduire les coûts de production tout en renforçant l'autonomie technologique des systèmes agricoles locaux. Elle constitue ainsi un levier stratégique pour la diffusion de solutions phytosanitaires durables adaptées aux contextes tropicaux

Référence bibliographique: Bilé *et al.*, 2025. Valorization of agricultural and industrial wastes to produce *Trichoderma virens*, an effective plant disease biocontrol agent. *Waste & Biomass Valorization* 16(8): 4365-4380. DOI: 10.1007/s12649025-02888-y

Assessing Smallholder Farmers' Vulnerability to Extreme Climate Events Across Agroecological Zones in the Sidama Region, Ethiopia

Yoseph Yisehake

Hawassa University, Ethiopia

Ethiopia is widely recognized as highly vulnerable to climate extremes, primarily because its agriculture-based economy is highly sensitive to climate variability and precipitation changes. Household livelihood vulnerability, however, varies across different agroecological zones (AEZs). Despite this, empirical research examining how vulnerability to extreme climate events differs by AEZ remains limited. This study addresses this gap by providing AEZ-specific evidence on the livelihood vulnerability of smallholder farmers in the Sidama Region, Ethiopia. A total of 377 farmers were selected from three AEZs using simple random sampling. Qualitative data from focus group discussions, key informant interviews, and field observations complemented the quantitative analysis. The Livelihood Vulnerability Index (LVI) and the LVI–IPCC framework was applied to assess vulnerability through three key dimensions: exposure, sensitivity and adaptive capacity. Findings reveal notable disparities in vulnerability components across AEZs. The lowland AEZ showed the highest exposure (0.24), largely due to more frequent extreme climate variability and natural disasters. Sensitivity was also highest in the lowland (0.32), reflecting unsustainable land use, greater agricultural dependence and food insecurity. In contrast, adaptive capacity was relatively similar across AEZs, with index values of 0.16 in the highland, 0.15 in the midland and 0.14 in the lowland. The overall LVI was highest in the lowland (0.23), followed by the midland (0.22) and the highland (0.21), indicating a gradient of increasing vulnerability with declining altitude. Similarly, the LVI–IPCC index confirmed greater vulnerability in the lowland (0.03) compared to the midland (0.02) and the highland (0.01). The findings underscore the urgent need for AEZ-specific adaptation strategies to strengthen resilience and reduce livelihood vulnerability among smallholder farmers in the Sidama Region.

Assessing Smallholder Farmers' Vulnerability to Extreme Climate Events Across Agroecological Zones in the Sidama Region, Ethiopia

Research Paper Presented to the 1st TSARA Science Days

Yoseph Yisehake

PhD Candidate at Hawassa university, Ethiopia. Email: yosephyisake79@gmail.com

February, 2026
Hawassa University, Hawassa, Ethiopia

Introduction

Climate Change & Extreme Events

- Climate change is increasing the frequency & intensity of extreme events like droughts, floods, storms & heatwaves threaten ecosystems, food systems & human well-being (IPCC, 2023).

- Africa is highly vulnerable due to rainfed agriculture, weak infrastructure & poverty, impacts overwhelmingly negative for livelihoods .

Understanding Vulnerability

- Vulnerability = susceptibility to harm from climate hazards (UNDRR 2021).
- In climate science:

    - Exposure – degree of contact with hazards
    - Sensitivity – how strongly systems are affected
    - Adaptive Capacity – ability to cope, adjust & recover
    - Rooted in social, economic, environmental conditions.

Ethiopia's Climate Vulnerability

- High dependence on rainfed agriculture → high exposure.
- Recurrent droughts, floods & rainfall variability.
- Limited infrastructure & adaptive capacity.
- Studies show increasing future risks.

Sidama Region Context

- Climate-sensitive agriculture dominates livelihoods.
- Challenges: erratic rainfall, recurrent drought, occasional flooding.
- Constraints: low irrigation access, limited technology, weak safety nets.
- Impacts include crop failure, livestock loss, income instability.

Gaps in Existing Research

- Many Ethiopian studies are national or regional → lack local specificity.
- Limited focus on southern Ethiopia & Sidama region.
- Few studies disaggregate by agroecological zones (AEZs).
- Social & livelihood dimensions often overlooked.

Why AEZ-Specific Analysis Matters

- Vulnerability varies across lowland, midland, highland zones.
- Lowlands often → higher exposure, sensitivity & lower adaptive capacity.
- Sidama region lacks AEZ-specific, multidimensional vulnerability assessments.

Study Significance

•Integrates biophysical + socio-economic + AEZ dimensions.

•Uses LVI-IPCC to compute exposure, sensitivity & adaptive capacity.

•Provides granular, location-specific evidence for adaptation planning.

•Supports development of AEZ-tailored climate resilience strategies.

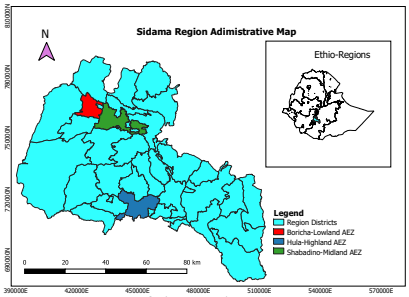
Study Objectives

1.Measure & compare livelihood vulnerability across Sidama's AEZs.

2.Quantify exposure, sensitivity & adaptive capacity for smallholder farmers.

2. Materials and Methods

Study area



Map of the study area

- **Sample:** 377 farmers from 3 AEZs (highland, midland, lowland).

District name	Kebele name	Total households	Sampled households	Total
Boricha	Hanja-Cafa	1142	66	126
	Haldada-Dela	1034	60	
Shabadino	Sedeka	1530	88	149
	Howolso	1058	61	
Hula	Witabono	843	49	102
	Chelbessa	914	53	
Total		6521	377	377

- **Data:** household survey + FGDs + KIIs + field observations.
- **Framework:** LVI and LVI–IPCC.
- **Dimensions:** exposure, sensitivity, adaptive capacity.

Vulnerability factors, livelihood capitals, major, and sub -components (indicators) for LVI analysis

LVI-IPCC-CF	Livelihood capitals	Major components	Indicators	Measure	Source
Exposure	Natural	Extreme climate variability	Value of Ave. monthly max. value of daily max. temp. (TXx) (1985-2018) (°C) (+)	normalized from 0-1	Neset et al. (2019), Maru et al. (2021a), Arifah et al. (2022)
			Value of Ave. monthly min. value of daily min. temp. (TNn) (1985-2018) (°C) (+)	normalized from 0-1	
			Value of Ave. monthly total wet day precipitation (PRCPTOT) (mm) (1985-2018) (+)	normalized from 0-1	
		Natural disasters	Drought events over 20 years (+)	1 if happen, 0 otherwise	Asfaw et al. (2021b); Ahmed et al. (2023); Tessema and Simane (2019b)
			Flood events over 20 years (+)	1 if happen, 0 otherwise	
			Crop disease incidence over 20 years (+)	1 if happen, 0 otherwise	
			Livestock disease incidence over 20 Years (+)	1 if happen, 0 otherwise	
Sensitivity	Natural	Land use & sustainability	Farm land soil fertile level (-)	0-3 scale, where 3=highly infertile	Maru et al. (2021a), Adu et al. (2018), Asfaw et al. (2021b), Ahmed et al. (2023)
			Climate Smart Agriculture Practices (CSA) (-)	1 practice, 0 otherwise	
		Water availability	% of households reported no water available for farming/irrigation activities	Normalized from 0-1	Adu et al. (2018), Ho et al. (2021)
		Food security	Ave.no. of food gap months from own production	0-2 scale, where 0=food insecure and 2=food secure	Adu et al. (2018), Arifah et al. (2022)
		Health	Average travel distance to a health facility (km)	Normalized from 0-1	Adu et al. (2018), Ho et al. (2021)
		Agriculture	Trend of crop productivity (-)	1-5 scale, where 5=highly increased	
Adaptive capacity	Financial	Wealth	Livestock holdings (TLU) (+)	Normalized from 0-1	Zeleke et al. (2023), Omerkhil et al. (2020), Zeleke et al. (2021b),
			Income from agriculture (ETB)	Normalized from 0-1	
			Cultivated farm size (ha) (+)	Normalized from 0-1	
			Estimated value of productive assets (ETB) (+)	Normalized from 0-1	
			Access to credit (+)	0-1 scale, where 1=full access	
	Physical	Technology	% of farm chemical fertilizers application (+)	0-1 scale, where 1=full application	Simane et al. (2016), Zeleke et al. (2021c), Belay & Lebeza (2024)
			% of farm chemicals application (+)	0-1 scale, where 1=full application	
			% of improved seeds application (+)	0-1 scale, where 1=full application	
			Access to irrigation (+)	0-1 scale, where 1=full access	
		Infrastructure	Access to health care centre (+)	0-1 scale, where 1=full access	Huong et al. (2019), Maru et al. (2021a), Ghosh and Ghosal (2020), Dendir and Simane (2019b)
			Access to school (+)	0-1 scale, where 1=full access	
			Access to drinking water (+)	0-1 scale, where 1=full access	
			Access to veterinary service (+)	0-1 scale, where 1=full access	
			Access to market (+)	0-1 scale, where 1=full access	
	Human	Knowledge/skill	Education level of household head (+)	Normalized from 0-1	Belay and Lebeza (2024), Asfaw et al. (2021a)
			Access to climate information (+)	0-1 scale, where 1=full access	
			Attending on any training (+)	Normalized from 0-1	
			Off-farm income (ETB) (+)	Normalized from 0-1	

4. Results

Key Results – Exposure

- Highest in **lowland**: **0.24**.

LVI-IPCC-CF	Sub-components (indicators)	HL	ML	LL	Major components	HL	ML	LL
Exposure (E)	Normalized value of Ave. monthly total wet day precipitation (PRCPTOT) (mm) (1985-2018)	0.12	0.13	0.13				
	Normalized value of Ave. monthly max. value of daily max. temp. (TXx) (1985-2018) (°C)	0.13	0.05	0.14	Extreme climate variability	0.12	0.11	0.15
	Normalized value of Ave. monthly min. value of daily min. temp. (TNn) (1985-2018) (°C)	0.12	0.16	0.18				
	Drought events over 20 years	0.37	0.39	0.47				
	Flood events over 20 years	0.37	0.41	0.42	Natural disasters	0.27	0.29	0.33
	Crop disease incidence over 20 years (+)	0.02	0.02	0.31				
	Livestock disease incidence over 20 Years (+)	0.32	0.34	0.11				
	Exposure LVI					0.20	0.20	0.24

•Drivers: frequent climate variability & natural disasters.

Key Results – Sensitivity

- Highest in lowland: 0.32.

LVI -IPCC-CF	Sub-components (indicators)				Major components			
		HL	ML	LL		HL	ML	LL
Sensitivity (S)	Farm land soil fertile level	0.15	0.21	0.28	Land use & sustainability	0.15	0.21	0.28
	Climate smart agriculture practices (CSA)	0.15	0.20	0.27				
	Trend of crop productivity	0.21	0.28	0.31	Agriculture	0.21	0.28	0.31
	Ave.no. of food gap months from own production	0.30	0.40	0.06	Food security	0.30	0.40	0.06
	Water availability for farming/irrigation activities	0.38	0.23	0.48	Water availability	0.38	0.23	0.48
	Average traveling distance to a health facility (km)	0.31	0.37	0.46	Health	0.31	0.37	0.46
	Sensitivity LVI					0.27	0.30	0.32

- Causes: unsustainable land use, dependence on agriculture, food insecurity.

Key Results – Adaptive Capacity

- Highland: **0.16,** Midland: **0.1 and** Lowland: **0.14**

LVI -IPCC -CF	Sub-components (indicators)	HL	ML	LL	Major components	HL	ML	LL
Adaptive Capacity (AC)	Livestock holdings (TLU) (+)	0.09	0.13	0.14	Wealth	0.09	0.11	0.10
	Income from agriculture (ETB) (+)	0.08	0.19	0.07				
	Cultivated farm size (ha) (+)	0.09	0.06	0.03				
	Estimated value of productive assets (ETB)(+)	0.10	0.12	0.22				
	Access to credit (+)	0.09	0.06	0.02	Technology	0.15	0.19	0.14
	% of farm chemical fertilizers application (+)	0.33	0.34	0.24				
	% of farm chemicals application (+)	0.18	0.02	0.19				
	% of improved seeds application (+)	0.04	0.01	0.08				
	Access to irrigation (+)	0.03	0.40	0.05	Infrastructure	0.16	0.11	0.16
	Access to health care centre(+)	0.09	0.01	0.24				
	Access to school(+)	0.20	0.09	0.17				
	Access to clean drinking water(+)	0.05	0.13	0.06				
	Access to veterinary service(+)	0.26	0.09	0.03				
	Access to market(+)	0.22	0.24	0.30				
	Education level of household head (+)	0.03	0.07	0.05	Knowledge/skill	0.14	0.14	0.16
	Access to climate information (+)	0.22	0.14	0.19				
	Attending on any training (+)	0.16	0.20	0.23				
	Off-farm income (ETB) (+)	0.24	0.23	0.21	Livelihood strategy	0.22	0.22	0.21
	Non-farm income (ETB) (+)	0.20	0.21	0.20				
	Farm experience (year) (+)	0.22	0.17	0.10	Socio-demographic	0.19	0.16	0.16
	Dependency ratio (inverse)(+)	0.15	0.15	0.21				
	Help from others (+)	0.12	0.17	0.08				
	Involvement in household asset building program (HABP) (+)	0.21	0.14	0.03	Social network	0.18	0.12	0.07
	Involvement in informal association (Iddir, Equib) (+)	0.19	0.11	0.15				
	Involvement in disaster reduction and early warning committee (+)	0.18	0.04	0.03				
	Adaptive capacity LVI					0.16	0.15	0.14

- Indicates uniformly limited adaptive resources.

Overall Vulnerability (LVI)

- Lowland: 0.23
- Midland: 0.22
- Highland: 0.21→ Vulnerability increases with declining altitude.

Sub-components (indicators)				Majo components			
	HL	ML	LL		Highland	Midland	Lowland
Extreme climate variability	0.12	0.11	0.15		0.20	0.20	0.24
Natural disasters	0.27	0.29	0.33	Exposure			
Land use and sustainability	0.15	0.21	0.28				
Agriculture	0.21	0.28	0.31				
Food security	0.30	0.40	0.06				
Water availability	0.38	0.23	0.48	Sensitivity	0.27	0.30	0.32
Health	0.31	0.37	0.46				
Wealth	0.09	0.11	0.1				
Technology	0.15	0.19	0.14				
Infrastructure	0.16	0.11	0.16				
Knowledge/skill	0.14	0.14	0.16	Adaptive capacity	0.16	0.15	0.14
Livelihood strategy	0.22	0.22	0.21				
Sociodemographic	0.19	0.16	0.16				
Social network	0.18	0.12	0.07				
Over all LVI					0.21	0.22	0.23
LVI -IPCC = $S_r \times (E_r - A_{Cr})$					0.01	0.02	0.03

LVI–IPCC Index

- Lowland: 0.03, Midland: 0.02, Highland: 0.01

  → Confirms lowland farmers most vulnerable.

Conclusion

- Significant AEZ differences in vulnerability components.
- Lowland households face the greatest risks.
- AEZ-specific adaptation strategies urgently needed to strengthen resilience.

Biological indicators and agroecological transition: responses of microarthropods in two Moroccan Living Labs

Outmane El Omry, Ghizlane Echchghadda
École Nationale d'Agriculture de Meknès (ENAM), Morocco;
Université Sidi Mohamed Ben Abdellah (USMBA), Morocco.

Amina Bari
Université Sidi Mohamed Ben Abdellah, Morocco

Soil resource degradation—particularly the loss of soil quality and biodiversity—represents a major global challenge threatening the long-term sustainability of ecosystems. This issue is closely linked to unsustainable agricultural practices that alter soil fauna, which plays a critical role in soil functioning (nutrient cycling, structure formation, and water regulation). Soil arthropods, which represent more than 85% of the species richness of this fauna, are widely recognised as bioindicators of soil quality (QBS-ar index) (Blasi et al., 2013; Tóth et al., 2025) due to their high sensitivity to anthropogenic disturbances.

In this context, and within the framework of the NATAE project, this study aims to assess the impact of agroecological practices compared to conventional agriculture on microarthropod communities, while accounting for climatic variability across two distinct regions: Skoura M'daz and Ait Othmane.

The methodology combines the use of the QBS-ar index with the analysis of physicochemical soil parameters (pH, organic matter, total nitrogen, available phosphorus) and pollutants (Pb, Cd, Cu, Fe, Cr). The study systematically compares the two production systems within each site: in Ait Othmane (a peri-urban lowland area), sampling was conducted on three agroecological farms and one conventional farm, while in Skoura M'daz (a mountainous area), one agroecological farm was compared with one conventional farm. Sampling was performed with three replicates per farm. In addition, a cross-site comparison between the two Living Labs was carried out.

This approach makes it possible to analyse the complex interactions between agricultural practices, soil properties, and environmental factors in order to better understand both linear and non-linear relationships between soil biological quality and biodiversity dynamics under different farming systems.

Indicateurs Biologiques et Transition Agroécologique

Réponse des Microarthropodes dans Deux Living Labs Marocains

El Omry Outmane[1,2], Bari Amina[2],Echchghadda Ghizlane[1]

Projet NATAE | Thématique : Transition Agroécologique

1st Scinces days
January 13 2026

El Omry Outmane
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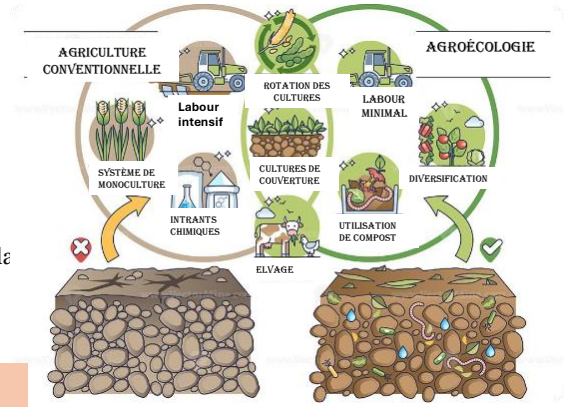
Un Enjeu Planétaire

La dégradation des ressources naturelles menace la **durabilité des agroystèmes**.

Les pratiques agricoles intensives altèrent la **faune édaphique**.

Conséquences : Perturbation du cycle des nutriments, de la structure du sol et de la régulation hydrique.



Besoin Urgent : Des outils de diagnostic sensibles pour évaluer l'impact des pratiques agricoles sur les sols.

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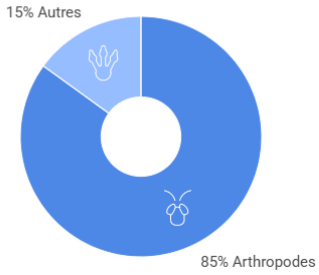
Microarthropodes Bioindicateurs

Représentent > **85%** de la richesse spécifique du sol.

Extrêmement sensibles aux perturbations anthropiques (labour, pesticides).



L'Indice QBS-ar

(Qualité Biologique du Sol - arthropodes)

Mesure le niveau d'adaptation morphologique à la vie souterraine. Plus la valeur est élevée, meilleure est la qualité biologique.

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objectif

Objectif Global

Évaluer l'impact de la transition agroécologique vs agriculture conventionnelle sur la biodiversité du sol.

Objectifs Spécifiques

- Comparer les communautés de microarthropodes sous différents modes de gestion
- Intégrer les variations climatiques (Plaine vs Montagne).
- Corréler la biodiversité aux paramètres physico-chimiques et aux polluants

Originalité : Comparaison intra-site et inter-site (Living Labs).

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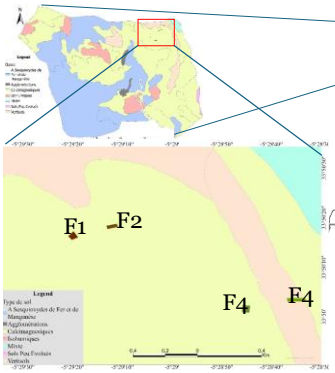
Matériel et méthodes

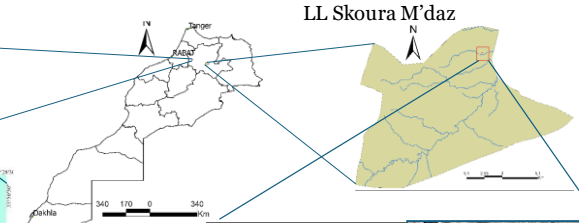
Zone d'étude

LL Aït Otmane



Zone pré-urbaine de plaine

LL Skoura M'daz





Zone montagneuse

Matériel et méthode

Echantillonnage et Analyses des sols

Échantillonnage et traitement des sols



Fig.3. Échantillonnage des sols

Trois répétitions par ferme, à une profondeur de 30 cm.



Fig.3.Traitement de sol

Les sols ont été séchés à l'air libre, broyés et tamisés à 2 mm

Matériel et méthode

La fertilité chimique

- ❑ **Potentiel hydrogène (pH),**
- ❑ **Matière organique (MO),**
- ❑ **Azote total (TN)**
- ❑ **Phosphore assimilable PA**
- ❑ **conductivité électrique (CE).**

Métaux lourds

- ❑ **Plomb (Pb),**
- ❑ **Cadmium (Cd),**
- ❑ **Cuivre (Cu),**
- ❑ **Fer (Fe)**
- ❑ **Chrome (Cr)**

Matériel et méthode

Echantillonnage et extraction arthropodes du sol

Echantillons de sol de 10 × 10 × 10 cm avec 3 répétitions Par ferme avec 5 m 10

Extraction continue sur **7 à 10 jours** jusqu'à dessiccation complète des échantillons de sol

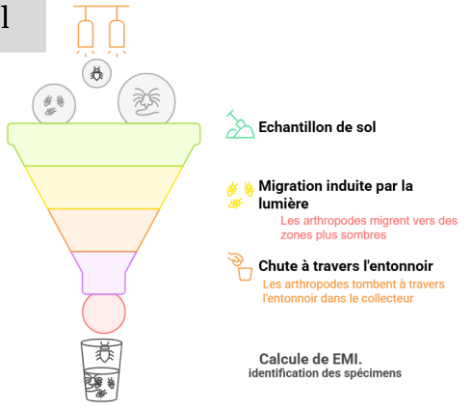


Fig.5: Extraction par la méthode de Berlèse

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Matériel et méthode

Calcul de QBS-ar

Déterminer les indices éco-morphologiques (EMI).

Calculer QBS-ar

additionner les EMI de tous les groupes collectés, par échantillon et par ferme

Abondance (**nb ind/m²**)

abondance par famille

Comparer le QBS-ar et les autres paramètres entre les fermes des deux Living Labs.

tableau1 : Eco -morphological score (EMI).

Group	EMI score
Protura	20
Diplura	20
Collembola	1–20
Microcoryphia	10
Zygentomata	10
Dermaptera	1
Orthoptera	1–20
Embioptera	10
Blattaria	5
Psocoptera	1
Hemiptera	1–10
Thysanoptera	1
Coleoptera	1–20
Hymenoptera	1–5
Diptera (larvae)	10
Other holometabolous insects (larvae)	10
Other holometabolous insects (adults)	1
Acari	20
Araneae	1–5
Opiliones	10
Palpigradi	20
Pseudoscorpiones	20
Isopoda	10
Chilopoda	10–20
Diplopoda	10–20
Pauropoda	20
Symphyla	20

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Résultats Attendus & Hypothèses

Les fermes agroécologiques présenteront un **QBS-ar significativement plus élevé** (biodiversité plus adaptée) que les fermes conventionnelles.

Impact des Pratiques

Corrélation positive entre **Matière Organique** et richesse spécifique.
Corrélation négative avec les polluants (Pb, Cd, Cu).

Interactions Chimiques

La structure des communautés différera entre la zone montagneuse (Skoura) et la plaine (Ait Othmane) due aux paramètres liée avec les sols.

Effet "Site"

La structure des communautés différera entre la zone montagneuse (Skoura) et la plaine (Ait Othmane) due aux conditions physiques et climatiques (climat, altitude, pente).

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Conclusion

Cette approche permet d'analyser les interactions complexes entre les pratiques agricoles, les propriétés des sols et les facteurs environnementaux, afin de déterminer et comprendre les interactions linéaires et non linéaires, entre la qualité biologique des sols et les dynamiques de biodiversité des sols sous différentes pratique agricoles.

Posters Agroécological transition

Evaluation of the Potential Impact of the Agroecological Transition (AET) of Agricultural Farms in the Province of Khémisset: Application of the Target MOTAD Model

Afaf SARI - ENAM
Khalil ALLALI – ENAM

The agroecological transition represents a strategic response for farming systems facing increasing economic, environmental, and social challenges. This study assesses, through prospective modelling, the economic potential of adopting agroecological practices in the Khémisset Province, Morocco. A sample of 120 farms was analysed and classified into three size categories: small (≤ 5 ha), medium (5–20 ha), and large (≥ 20 ha). The TARGET MOTAD model was used to simulate a range of scenarios, including reductions in pesticide inputs by 15%, 30%, and 50%; crop diversification; livestock manure valorisation; and combinations of these strategies.

The results reveal substantial differences among farm size categories. For small farms (≤ 5 ha), a 15% reduction in chemical inputs would result in an approximately 9% decline in gross margin, although manure valorisation could offset this loss by about MAD 620. For medium-sized farms (5–20 ha), profitability would remain acceptable even with a 50% reduction in chemical inputs, provided that crop diversification and crop–livestock integration were implemented simultaneously. In contrast, large farms (≥ 20 ha) would experience a nearly 22% reduction in gross margin with only a 15% decrease in chemical inputs, highlighting the vulnerability of specialised intensive production systems.

Combined scenarios generated additional economic benefits, with manure valorisation reaching nearly MAD 40,000 on large farms, illustrating the synergies that can arise from integrating multiple agroecological practices. These findings underscore the importance of crop diversification and the efficient use of on-farm resources in strengthening both farm autonomy and economic performance.

Overall, the study demonstrates that the agroecological transition is economically feasible, but its implementation should be tailored to farm size. Small farms would benefit primarily from improved valorisation of internal resources, medium-sized farms from combining crop diversification with crop–livestock integration, while large farms would need to redesign their intensive production systems to reduce their dependence on chemical inputs.

AUTHOR, CO -AUTHORS, INSTITUTION
Mme Afaf SARI
Pr.ALLALI Khalil
ENA -Meknès

Evaluation of the Potential Impact of the Agroecological Transition (AET) of Agricultur Farms in the Province of Khémisset: Application of the Target MOTAD Model

ABSTRACT

This study assesses the economic viability of the agroecological transition in the province of Khémisset through the TARGET MOTAD model, drawing on a sample of 120 farms. The findings reveal heterogeneous impacts according to farm size, cropping diversification, and the ability to valorize internal resources, which support the profitability of small- and medium-scale farms. The agroecological transition appears economically achievable, contingent upon the adaptation of strategies to farm size classes.

INTRODUCTION

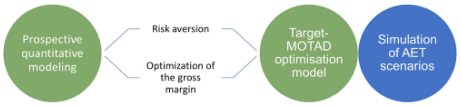
Farms face increasing climate variability, soil degradation, and dependence on chemical inputs, undermining their economic viability The agroecological transition (AET) offers a pathway to combine sustainability and performance, but its economic impacts and adoption conditions remain poorly documented

Research questions:

- How does AET affect farm profitability?
- Which farm profiles present the highest transition potential?
- What constraints and drivers shape adoption?

METHODOLOGY

Sample: 120 farms in the Khémisset province
Method: Prospective modeling (TARGET MOTAD) combined with Monte Carlo simulations
Scenarios & Instruments: Reduced pesticide use, crop diversification, and enhanced valorization of manure and internal resources; modeling implemented in GAMS

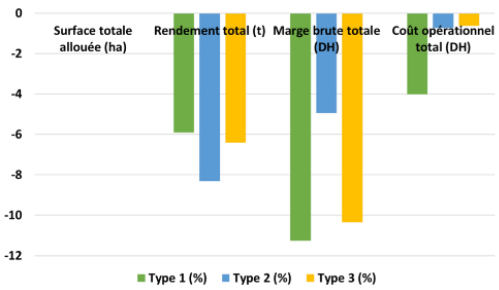


DISCUSSION

Type 1 – Small farms (< 5 ha; mixed family systems): moderate sensitivity profitability only affected once phytosanitary inputs are reduced by more than 30%.
Type 2 – Medium farms (5–20 ha; diversified cereal–forage) strong crop–livestock integration gross margins remain stable even at −50% input use; high synergistic effects
Type 3 – Large farms (> 20 ha; intensive arboriculture viticulture) limited crop–livestock integration margins decline as soon as input use drops by ~15%; high dependence on chemical inputs

RESULTS

Model validation: simulation–reality discrepancies were mostly below 5%, supporting the robustness of t prospective assessment.
The economic potential of the agroecological transition differs markedly across farm types:



Potential impact of a 30% reduction in pesticide treatments.

Evaluating the Potential Impact of Crossed Scenarios, Type 2 (Medium Farms, 5–20 ha)

Indicator	−15%	−30%	−50%	Evolution −15% → −30%
Gross Margin (before valorization)	8,171,936 DH	7,191,186 DH	5,935,967 DH	−12.0%
Gross Margin (after valorization)	8,254,588 DH	7,273,838 DH	6,018,619 DH	−11.9%
Relative Gross Margin Gain (%)	1.00%	1.15%	1.39%	15.00%
Labor Productivity (t/h)	0.023	0.0213	0.0191	−7.4%
Mineral Fertilizer Savings (DH)	82,652 DH	82,652 DH	82,652 DH	0%

CONCLUSION

The agroecological transition can be economically viable, yet its potential depends strongly on farm type and the degree of livestock integration. Small and medium-sized farms, thanks to diversification and manure valorization, exhibit the best economic performance under input reduction. Conversely, intensive systems with low integration remain more vulnerable, underscoring the need for differentiated transition strategies.

Faire tenir une ferme dans l'incertitude : une enquête mathématique au bord du lac de Guiers

Dame Thiaw, Ecole Supérieur Polytechnique, UCAD, Sénégal
Etienne Delay, Cirad, France
Raphael Duboz, Cirad, Sénégal
Alassane Bah, Ecole Supérieur Polytechnique, UCAD, Sénégal
Alvarez, Isabelle, INRAE, France
Sophie Martin, INRAE, France

Le travail s'inscrit dans un contexte territorial marqué par des enjeux écologiques et socio-économiques centraux autour du lac de Guiers, principale réserve d'eau douce du Sénégal. Cette zone agricole irriguée est caractérisée par une forte pression sur les ressources hydriques et pédologiques, liée à l'intensification des cultures (manioc, riz, maraîchage) et à la dépendance aux intrants chimiques. Le projet Santés Territoires, vise à accompagner la transition agroécologique en l'articulant avec *One health*. Les diagnostics menés dans les villages riverains, notamment Mbane, ont fait émerger des préoccupations relatives à la dégradation des sols, à l'usage massif de pesticides, aux conflits d'usage autour de l'eau et à l'incertitude climatique. Dans ce contexte, l'enjeu du travail est de comprendre comment un système agricole irrigué peut rester viable sur le long terme, en conciliant productivité, préservation du sol et gestion rationnelle de l'eau.

Pour répondre à ces enjeux, l'étudiant mobilise la théorie de la viabilité. Cette approche est pertinente dans un environnement où l'optimisation classique ne suffit pas, les systèmes agricoles étant soumis à incertitudes climatiques, à variabilité hydrique et à des interactions complexes entre ressources naturelles et facteurs économiques. L'étudiant pose ainsi sa problématique autour de l'identification des combinaisons d'états (biomasse, fertilité du sol, capital économique, eau disponible) et d'actions (irrigation, investissements agroécologiques, récolte) capables de maintenir une ferme dans un ensemble d'états jugés acceptables.

Sur cette base, l'étudiant propose un modèle dynamique à quatre variables d'état — biomasse cultivée (B), fertilité du sol (S), capital économique (C) et disponibilité en eau (W) — formalisé sous forme d'un système d'équations différentielles. Ce modèle intègre des interactions non linéaires inspirées de la littérature. Un ensemble de contraintes écologiques et économiques sont définit sur la base d'atelier mener avec les paysans (seuils minimaux de biomasse, de fertilité, de capital et d'eau) permettant de caractériser les conditions minimales de durabilité. À l'aide de l'algorithme de Saint-Pierre et de l'outil ViabLab, il est alors possible de calculer le noyau de viabilité du système, génère des trajectoires viables et analyse les stratégies permettant de maintenir la durabilité dans différents scénarios. Cette méthodologie permet d'explorer les compromis entre ressources (capital–eau–sol) et d'identifier des configurations robustes pour la transition agroécologique dans le bassin du lac de Guiers.

Application de la théorie de la viabilité à la modélisation d'une ferme agroécologique

Dame Thiaw[1], Etienne Delay[2,3], Alassane Bah[2] et Raphaël Duboz[2,4]



Contexte et problématique

Le territoire étudié subit des usages concurrents de l'eau (agriculture intensive, eau potable, écosystèmes), et les pratiques agricoles dominantes exercent une forte pression sur les sols et la ressource en eau.



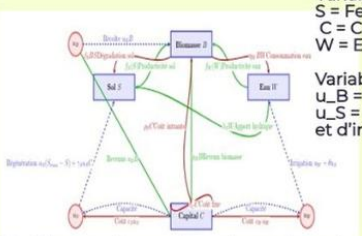
Comment rendre un système agricole irrigué durable et adaptable tout en restant productif ?

Modèle Dynamique et viabilité

La viabilité détermine les états permettant de respecter durablement les contraintes.

Variables d'état : B = Biomasse, S = Fertilité du sol (0–1), C = Capital économique, W = Eau disponible

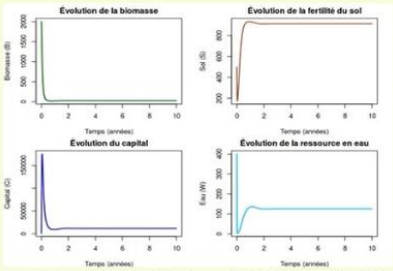
Variables de contrôle : u_B = Taux de récolte, u_S = Effort de régénération et d'irrigation (uW)



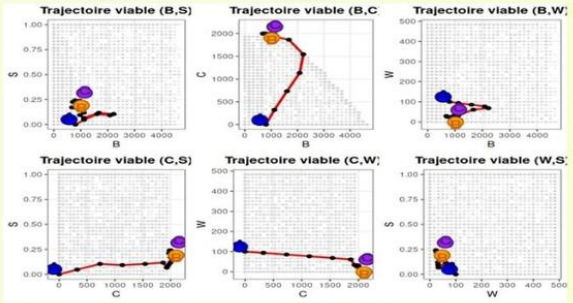
Modèle agro-économique dynamique : interactions entre production, ressources et capital, conciliant profit à court terme et durabilité à long terme.

Résultats

Évolution du systéme



Une production initiale élevée est non soutenable ; la régénération du sol conduit ensuite à un état durable.



1. Viabilité dominée par biomasse et sol ; capital et eau plus flexibles.,
2. Croissance puis stabilisation : biomasse modérée, sol et eau stables malgré le stress hydrique.

Conclusion

- Co-viabilité assurée par la fertilité du sol et une gestion en deux phases
- Cela ouvre des perspectives pour l'accompagnement des transitions agroécologiques à l'échelle des térritoires.

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3 Cirad, UMR Sens, universite Cheikh Anta Diop, Dakar
4. Cirad, UMR ASTRE, universite Cheikh Anta Diop, Dakar

EPITAG – EPIdemiological modelling and control for Tropical Agriculture

Suzanne Touzeau – INRAE

Samuel Bowong – University of Douala

EPITAG is an Inria Associate Team, established in 2017 through a scientific collaboration between France (Inria MACBES, INRAE ISA, and Cirad) and Cameroon (the Universities of Douala, Yaoundé I, and Dschang). From 2022 to 2024, the team also received support from TSARA and the French Embassy in Cameroon.

Its main objective is the mathematical and numerical study of epidemiology and the sustainable management of diseases and pests affecting tropical crops. The team uses tools from dynamical systems and control theory to better understand, predict, and mitigate crop damage.

The collaboration is built around the joint supervision of PhD students in applied mathematics, with research focusing on major food and cash crops in Cameroon.

EPITAG – EPIdemiological modelling and control for Tropical AGriculture

Suzanne TOUZEAU (INRAE, Inria, France) & Samuel BOWONG (Univ. Douala, Cameroon)

French & Cameroonian researchers and students, with a background in applied mathematics, and an interest in crop diseases

- 2017–2027 Inria **Associate Team**, part of IRIMA (renewed in 2020 and 2025)
- 2022–2024 INRAE through TSARA programme & support



Context

- Population & food demand are increasing
- Crop pests and diseases threaten food security
- Agriculture provides employment & revenues
  Cameroon: land 21%, work 43%, exports 17%, GDP 16%

➥ Controlling crop pests is a major issue

Chemical pesticides:
- negative impact on health & environment
- variable effectiveness, pest resistance
- high costs

➥ Need for sustainable eco-friendly alternatives

Objectives

Epidemiological modelling of tropical crop diseases, with a focus on Cameroon, using tools from dynamical systems and control theory


banana burrowing nematodes


coffee leaf rust

Challenges: "small data" & relevance of our models

Activities



Mobility
- students from Cameroon
  2–3 students/year, 3- to 5-month stays
- senior visits from France & Cameroon

EPITAG workshops

→ *foster interest in modelling and control for sustainable crop protection in Cameroon*
- Yaoundé, December 2017
- Dschang, November 2023
- Dschang, November 2025



Joint supervision of PhD students



Cocoa plant mirids
Myriam DJOUKWE TAPI
Univ. Douala, 2020
Senior lecturer Univ. Douala



Banana burrowing nematodes
Israël TANKAM CHEDJOU
Univ. Yaoundé I, 2022
Pdoc WAVE Ivory Coast & Univ. Cambridge; Pdoc INRAE Rennes



Coffee berry borers
Yves FOTSO FOTSO
Univ. Dschang, 2022
Lecturer Univ. Dschang; Pdoc INRAE Rennes
↓ example



Coffee leaf rust
Clotilde DJUIKEM
Univ. Côte d'Azur, 2023 (Inria grant)
ATER UniCA; Pdoc Univ. Manitoba, Canada



Cabbage diamondback moth
Aurélien KAMBEU YOUMBI
Univ. Dschang, ongoing



Banana burrowing nematodes
Frank KEMAYOU
Univ. Douala, ongoing



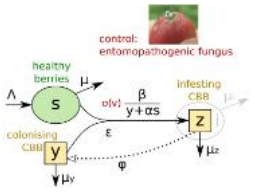
African cassava mosaic disease
Borel KENNE MELI
Univ. Yaoundé I, ongoing



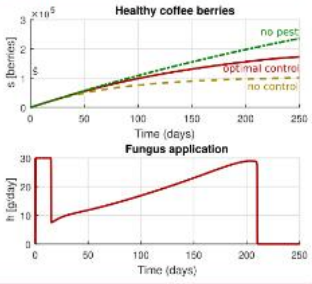








$$\begin{aligned}
\dot{s} &= \underset{\text{new berries}}{\Lambda} - \sigma(v)\,\beta\frac{sy}{y+\alpha s} \underset{\text{mortality}}{-\mu s}\\
\dot{y} &= \underset{\text{emergence}}{\varphi z} - \varepsilon\beta\frac{sy}{y+\alpha s} - \mu_y y\\
\dot{z} &= +\sigma(v)\,\varepsilon\beta\frac{sy}{y+\alpha s} - \mu_z z\\
\dot{v} &= \underset{\text{decay}}{-\gamma v} + \underset{\text{control}}{h(t)} \quad \leftarrow \text{fungus load}
\end{aligned}$$



[Mathematical Methods in the Applied Sciences 2021; Applied Mathematical Modelling 2022; Journal of Optimization Theory and Applications 2023]

Support

- **Inria**, Associate Team programme, 2017–*2024*
- **INRAE**, TSARA programme, 2022–*2024*
- **French Embassy** in Cameroon, SCAC, 2023–*2024*
- **Inria** CORDI PhD grant, 2019–2022
- **AUF**, Collège doctoral régional Mathinbio, 2018–2020
- **EMS-Simons** for Africa programme, 2018
- **IRD**, UMMISCO
- **CIRAD**

More on EPITAG: https://team.inria.fr/epitag/

TSARA 1st Science Days, January 2026

Insecticide resistance

Ki-Woong Nam – INRAE & Univ. Montpellier

Insecticide resistance is one of the main challenges in agriculture. The use of insecticides negatively impacts not only the ecosystem, but also the health of farmers and customers. Despite our efforts, the use of insecticides has been constantly increasing worldwide, necessitating urgent action to tackle this trend.

Regarding lepidopteran pest insects, if we are able to predict insecticide resistance from trapped adults, it will be possible to avoid resistance in their descendants by finding the optimal type of insecticide, especially because massive outbreaks occur. This prediction will provide practical ways of reducing insecticide use by avoiding over-sprays.

Since insecticide resistance might occur through the action of a very large number of detoxification genes, it is often very difficult to predict the resistance. Single-gene molecular markers have been proposed to predict resistance, but this method works only if we have information that the resistance is caused solely by the corresponding gene.

To tackle these challenges, we will use AI-based approaches. Once we have a sufficient number of resistance samples, we will be able to train machines to associate whole-genome sequences with specific types of insecticide resistance through supervised machine learning. We will focus on two pest species, Spodoptera frugiperda and Helicoverpa armigera, which are among the most damaging pest insects in Africa. Since a very large amount of resequencing data is available for these species, it will be straightforward to include African resistant samples in these existing datasets for machine learning. Therefore, it is very important to have both resistant and susceptible S. frugiperda and H. armigera insects in Africa.

This method could potentially innovate our predictability of insecticide resistance, hence ultimately providing sustainable agriculture in Africa.

Insecticide resistance

If we know insects have resistance to B





If we know insects **do not** have resistance to A or B



If we do not know the resistance to B



⟶ Overuse

But, there is almost no way to predict

New era: Solution by big data with machine-learning (AI) + Genomics



Spodoptera frugiperda
(Fall armyworm)



Helicoverpa armigera
(Cotton bollworm)

⟹ World-wide pest, but serious in Africa

⟹ Major pest against maize, cotton, and tomato

⟹ Frequent insecticide resistance (272 and 892)

Many African samples with resistance or not

↓

NGS

↓

Machine-Learning Model for prediction

If you know any sample availability, please inform me

Funding is already obtained

Nagoya protocol is already solved from 29 countries

Rural Developmen Administration

1st Science Days
January 13 2026

NAM Kiwoong
AI Resistance Prediction

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Interactions between companion and cacao trees (Theobroma cacao L.) along a soil acidity gradient in cocoa-based agroforestry systems in Ivory Coast

Emile Bolou Bi – INRAE

Insecticide resistance is one of the major challenges facing modern agriculture. The widespread use of insecticides has detrimental effects not only on ecosystems but also on the health of farmers and consumers. Despite considerable efforts to reduce pesticide dependency, insecticide use has continued to increase globally, highlighting the urgent need for innovative strategies to reverse this trend.

For lepidopteran pest insects, the ability to predict insecticide resistance from trapped adult individuals would enable the selection of the most appropriate insecticide before large-scale infestations occur, thereby preventing the spread of resistance in subsequent generations. Such predictive tools would provide practical solutions for reducing insecticide use by avoiding unnecessary or ineffective applications.

However, predicting insecticide resistance remains challenging because resistance mechanisms often involve the combined action of numerous detoxification genes. Although single-gene molecular markers have been developed for resistance monitoring, they are effective only when resistance is known to be driven primarily by a specific gene.

To overcome these limitations, we propose to develop AI-based approaches for predicting insecticide resistance from genomic data. Once a sufficiently large collection of resistant and susceptible samples has been assembled, supervised machine learning models will be trained to associate whole-genome sequence variation with specific insecticide resistance phenotypes. The project will focus on two major lepidopteran pests, *Spodoptera frugiperda* and *Helicoverpa armigera*, which are among the most destructive agricultural pests in Africa. Extensive whole-genome resequencing datasets already exist for both species, making it possible to integrate newly collected African resistant and susceptible samples into these resources to build robust predictive models.

Establishing comprehensive collections of resistant and susceptible *S. frugiperda* and *H. armigera* populations across Africa will therefore be a key prerequisite for the success of this approach.

By combining genomics and artificial intelligence, this project has the potential to transform our ability to predict insecticide resistance before control failures occur. Ultimately, it will support more targeted pest management strategies, reduce unnecessary insecticide applications, and contribute to the development of more sustainable agricultural systems in Africa.

Interactions between companion and cacao trees (*Theobroma cacao* L.) along a soil acidity gradient in cocoa-based agroforestry systems in Ivory Coast.

Introduction

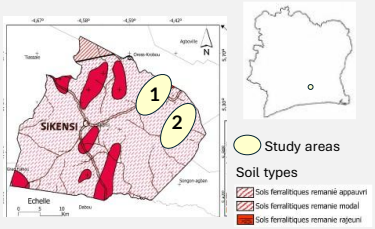
- The development of cocoa cultivation in Côte d'Ivoire has occurred at the expense of forest reserves.
- **Consequences:** Soil degradation; Land degradation; Reduction of forest reserves
- **Proposed solution: Agroforestry.**
- Introduction of cocoa farming models integrating companion trees with high edible and commercial value.
- However, edaphic tree-cocoa interactions and their effects on nutrient cycling remain poorly documented.

Objectives

- To inventory companion tree species in cocoa-based agroforestry systems,
- To study the impact of companion tree species on soil acidity (soil pH, base saturation and exchangeable acidity),
- To assess the impact on soil chemical fertility (availability of P, Ca^{2+}, Mg^{2+}, K^{+}).

Author contact *: bolou.bolou20@ufhb.edu.ci*

Material & Methods



- Two study areas including several cocoa plantations
- Botanical inventories of forest tree species
- Pedological prospections followed by a detailed assessment of soils surrounding companion trees (3 species selected), cocoa trees and fallow lands

  → Soil sampling down to 90 cm depth, within a radius of one meter around the tree

  → Laboratory analyses (C, N, $P_{available}$, Ca^{2+}, Mg^{2+}, K^{+})

Conclusion

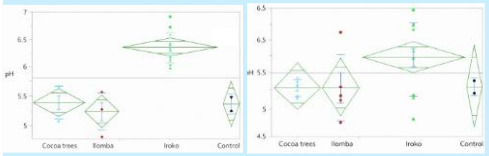
- Some companion tree species strongly influence soil pH and the availability of nutrient cations
- Iroko emerges as a key species for sustainable soil management in cocoa agroforestry systems

Results & Discussion

- **39 forest tree species categorized into 4 groups :**
  - 16 species : positive effect (**Iroko**, *Milicia excelsa*)
  - 5 species : negative effect (**Ilomba**, *Pycnanthus angolensis*)
  - 10 species : neutral effect (**Encens**, *Canarium schweinfurthii*)
  - 8 tree species as ambivalent effect

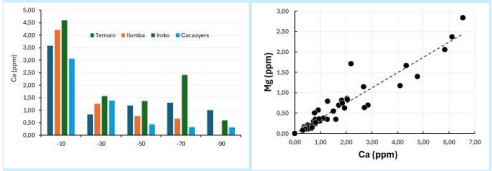
3 species selected for detailed study

- **Soil acidity**



→ Increase of soil pH by 0.40 to 0.75 units under Iroko trees

- **Availability of nutrient cations in soil**



→ Increase of nutrient cations under iroko trees

→ **Soil phosphorus availability :** analyses is in progress…

SESSION 2: SUSTAINABLE FOOD SYSTEMS

Session chair: **Mohamed Taher Sraïri**, IAV, Morocco

Parallel session A - Sustainability of food systems, food and nutritional security, health safety

Chaired by **Arlène Alpha**, Cirad and **Emmanuelle Maguin**, INRAE, France

Parallel session B - Food processing technologies and/or water-energy-food nexuses

Chaired by **Catherine Kunyanga**, U. of Nairobi, Kenya

Speakers, institutions & concerned countries

Joaquin AMELLER, CIRAD, Ethiopia, Kenya, South Africa, Uganda
Tesfaye Etensa GUTA, AAU, Ethiopia
Elodie MAITRE D'HOTEL, Cirad, Nigéria
Moez RHIMI, INRAE, Namibia
Francisca NGENDA KABOMBO, U. Nantes, Congo
Tadese Elleni TAMIRE, AAU, Ethiopia
Idrissa Nonmon SANOGO, Université de Ségou, Mali
Christel MAILLET, INRAE, Morocco
Bekele Wegi FEYISA, AAU, Ethiopia
Mamadou Tanou DIALLO, UGB, Senegal, Burkina Faso
Doriane Delacroix OUEDRAOGO, AgroParisTech, Senegal, Mali, Ghana, Niger, Malawi, Zambia, Togo, Mozambique,Uganda
Adeline BOIRE, INRAE, Cameroun
Aymar Rodrigue FOGANG MBA, Univ Douala, Cameroon
Fatou-Toutie NDOYE, INRAE, Senegal & Tanzania
Fadwa GUIMIMI, IAV Hassan II, Morocco
Marie-France, PILET, INRAE, Senegal
Oulaya, ZOUI, ENA Meknès, Morocco
Sarra, KEKLI, INRAE, Tunisia

Posters, authors, institutions & concerned countries

Hind MKADEM, IAV Hassan II, Morocco
Said BOUHALLAB, INRAE, Continent
Dominique AHOUANHODE, INRAE, Côte d'Ivoire
Molla Setargew MEKASHAW, AAU, Ethiopia
Nanwinyele Euvaris SOME, INERA, Burkina Faso

Parallel session A – Sustainability of food systems, food and nutritional security, health safety

Are healthier diets culturally affordable in Africa? Evidence from four African countries

Joaquin Ameller

Cirad, UMR MoISA, France

In 2023, between 713 and 757 million people experienced hunger globally, with Sub-Saharan Africa facing a prevalence of undernourishment at 20.4%. This study addresses the nutritional challenges affecting vulnerable groups, particularly women and young children, in eight African cities by modelling nutritionally adequate, economically affordable, and culturally acceptable diets. Our goal is to provide optimised diets for future consideration in food based national dietary guidelines for Ethiopia, Kenya, South Africa, and Uganda. We employ a mathematical programming approach to optimise diets, in order to achieve nutrient adequacy with minimal changes to current consumption patterns, under a budget constraint. The results show that nutritionally adequate diets are possible but often require dietary shifts, including increased intake of vegetables, fruits, and legumes, while moderately reducing the intake of cereals and, to a lesser extent, roots and tubers. Affordability remains a key constraint, some cities face larger tradeoffs than others, reflecting different levels of dietary diversity and purchasing power. Our discussion highlights the trade-off between cultural acceptability and economic affordability, suggesting that higher budgets may facilitate easier acceptance of dietary changes. Consequently, a focus on minimising food expenditures alone could compromise diet suitability by neglecting cultural acceptability. Lastly, we recommend a multifaceted policy approach to enhance frameworks for both demand and supply sides to achieve healthier diets.



Are healthier diets culturally affordable in Africa?

evidence from four African countries

J. Ameller[1], S. Drogue[1], K. Baye[2], M-J. Amiot[1], N. Kanerva[3], A. Le Port[1], M. Hoffman[4], A. Lubowa[5], G. Ampe[6], M. Fogelholm[3], Natalia Rosa-Sibakov[7]

[1] UMR MoISA, Univ Montpellier, CIHEAM-IAMM, CIRAD, INRAE, Institut Agro, IRD, Montpellier, France; [2] Addis Ababa University; [3] University of Helsinki; [4] University of Pretoria; [5] Independent consultant; [6] Makerere University; [7] VTT

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1st Science days
January 15th, 2026

innofood africa

InnoFoodAfrica project
https://www.innofoodafrica.eu/

cirad

Our goal

Provide optimized diets for contextualization of future food based national dietary guidelines across four African countries: Ethiopia, Kenya, South Africa, and Uganda.

Our approach

Use mathematical programming to model nutritionally adequate, economically affordable, and culturally acceptable diets for people in nutritionally vulnerable life-stages (women and young children) in 8 African cities.

What is diet optimisation

Mathematical Programming is a mathematical technique used to minimize or maximize an objective function subject to a set of constraints.



Applications:

- **Food -** To develop a new food product with the cheapest and most nutrient-dense mix of ingredients.
- **Nutrition & health** - Find an adequate diet that:
  - Minimizes toxic exposure, or
  - Minimizes the budget, or
  - Minimizes changes from an observed diet
  - …

Stigler, G. J., (1945) The cost of subsistence.

- minimum cost of an adequate diet
- reach *"Recommended Dietary Allowances"*
- restricted list of foods considered
- *"low-cost diets of the professional dieticians cost about two or three times as much as a minimum cost diet. ... dieticians take account of the palatability of foods, variety of diet, prestige of various foods, and other cultural facets of consumption."*

TABLE 2. MINIMUM COST ANNUAL DIETS, AUGUST 1939 AND 1944

Commodity	August 1939		August 1944	
	Quantity	Cost	Quantity	Cost
Wheat Flour	370 lb.	$13.33	535 lb.	$34.58
Evaporated Milk	57 cans	3.84	—	—
Cabbage	111 lb.	4.11	107 lb.	5.23
Spinach	23 lb.	1.85	13 lb.	1.56
Dried Navy Beans	285 lb.	16.80	—	—
Pancake Flour	—	—	134 lb.	13.06
Pork Liver	—	—	25 lb.	5.45
Total Cost		$39.93		$59.88

Darmon, N., et al (2006) Impact of a cost constraint on nutritionally adequate food choices for French women: an analysis by linear programming.

- minimized differences between observed and modeled diets
- based on the French nutrient recommendations (meet the nutrient needs of 97.5% of women)
- " for French women on a low food budget, a different food-based recommendation is required.... this pattern may be difficult to adopt, because many of these foods, notably offal, nuts, dried fruits and legumes, are not frequently consumed in France."

5

1- Context | Method | Results | Discussion

Masters, W. A., (2018) Measuring the affordability of nutritious diets in Africa: Price indexes for diet diversity and the cost of nutrient adequacy.

- Lowest-cost way to include five different food groups.
- Lowest-cost to meet estimated average requirements.
- *"These methods can show where and when nutritious diets are increasingly (un)affordable."*

Hirvonen, K. et al. (2020) Affordability of the EAT–Lancet reference diet: a global analysis.

- most affordable EAT-Lancet global benchmark diet
- minimum cost of nutrient adequacy
- *"Improving diets is affordable in many countries but for many people would require some combination of higher income, nutritional assistance, and lower prices."*

*RQ: Can we design nutrient-adequate diets that are feasible, affordable, and **culturally acceptable** in our case studies?*

6

4 countries: Ethiopia, Kenya, South Africa and Uganda.

8 cities: Addis Ababa, Hawassa, Nairobi, Chuka, Pretoria, Bloemfontein, Kampala and Wakiso.

Two participant types: mothers and their children (<2yo.) dyads.

→ **Survey :** (1) 24h recall to 1573 dyads (Aprox. 200 per location).

→ **Baseline Diet**
Energy targets: 2100kcal for women and 990kcal for children.

→ **Food groups**

Table 1. Food groups.

1	Cereals	8	Breast milk	15	Sugar and sweetened products
2	Roots and tubers	9	Meat and poultry	16	Nuts
3	Legumes	10	Eggs	17	Oils and fat
4	Vegetables	11	Fish and seafood	18	Spices
5	Fruits	12	Hot beverages	19	Insects
6	Fresh fruit juices	13	Sweetened beverages		
7	Dairy	14	Infant foods		

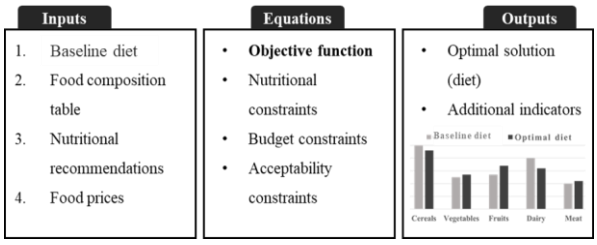
→ **Food composition table** Nutrient content of baseline diets and food groups

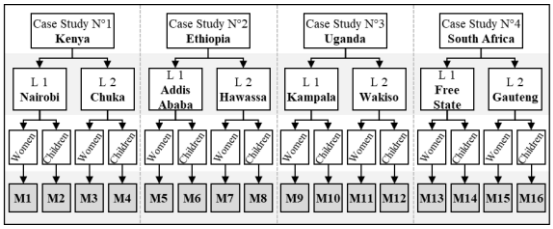
→ **Nutritional constraints** RNI table based on recommendations by WHO, FAO, EFSA.
Limited to the nutrients available in all countries' food composition tables

→ **Food prices** Provided upon request by the World Bank.

→ **Diet budget** Estimated with baseline diet and food prices.







Diet **sustainability :**

- ❑Nutritional adequacy
- ❑Economic affordability
- ❑Cultural acceptability
- ❑Environmental impact

Find a diet that abides to sustainability criteria, minimizing changes from the baseline diet.

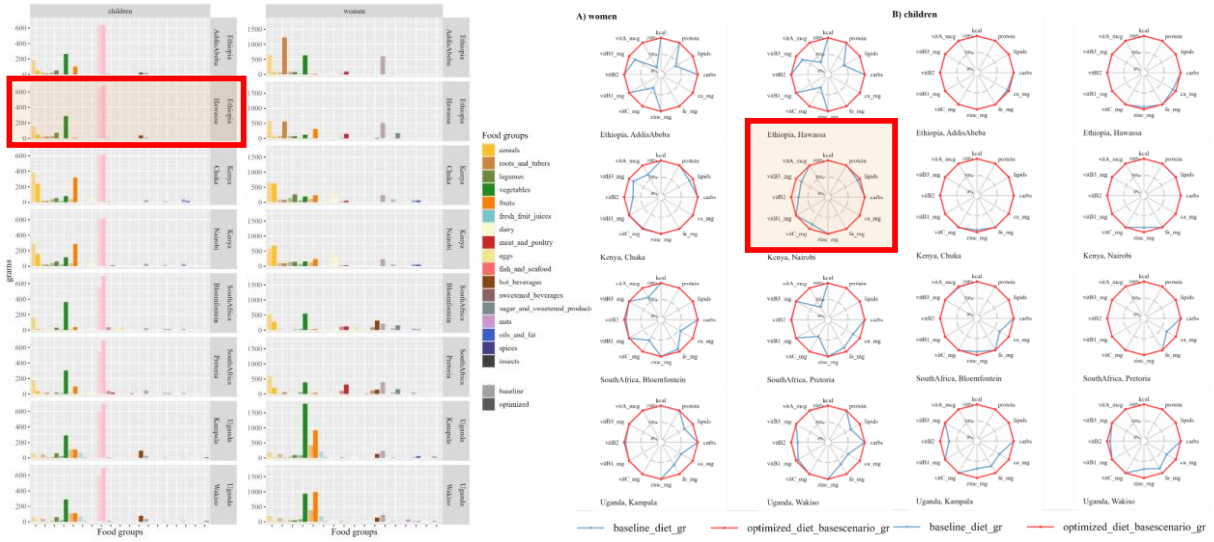
Optimized diet

$$MIN\ Z = \sum_i \left(\frac{X'_i - X_i}{X_i} \right)^2$$

Baseline diet

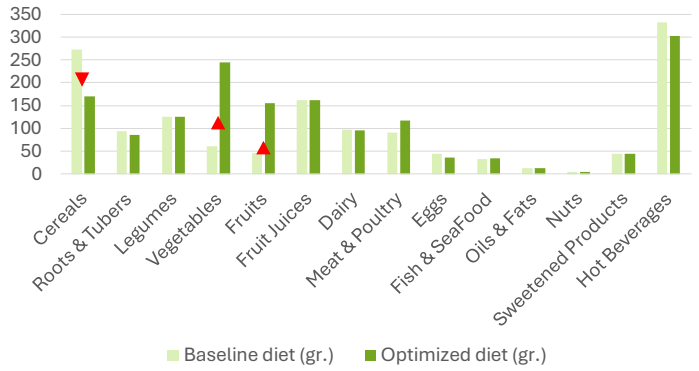
Find the minimal variations from the observed diet **(Acceptability)**.

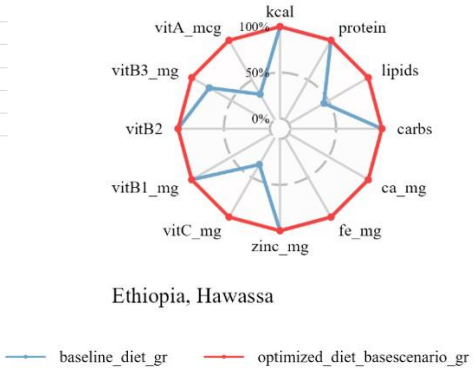
By squaring relative changes, large changes are more penalized than small changes, meaning that solutions will prioritize smaller changes rather than larger changes.



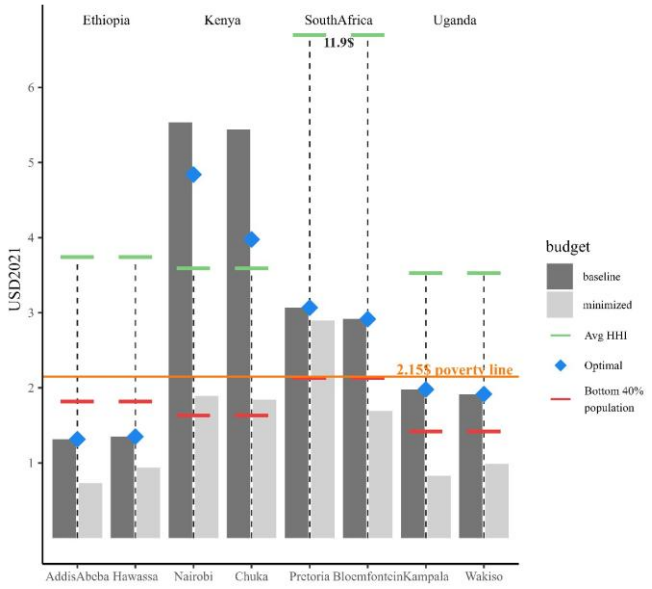
Hawassa's Women model

Feasibility

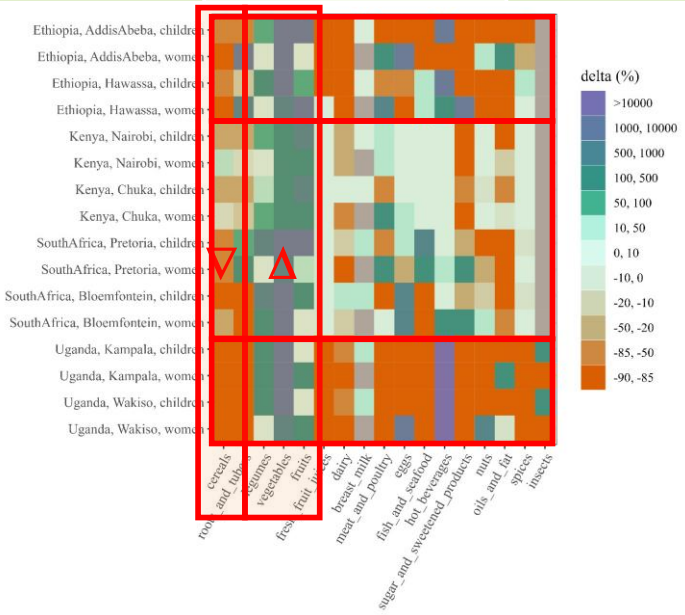




Affordability



Acceptability



innofood africa

The cultural acceptability modelling approach provides results that are more likely to be adopted by the population.

- For now, this is an assumption.
- As a decision-support tool, it can be used to discuss dietary guidelines.
- Sheds light on which food groups should public policies focus into

Caveats: *(1) Assumption: observed diet is proxy for preferences*
(2) Illimited supply, static prices, perfect substitution of goods/nutrients,
(3) nutrient data availability.

Findings show that healthier diets are not necessarily incompatible with the observed budgets.
...but the relative affordability and alignment with current cultural preferences remain limited.

Main recommendations: increase the intake of vegetables, fruits, and legumes, while moderately reducing the intake of cereals, roots and tubers

We open a discussion on how the suitability of modelled diets account for the tradeoffs between diet affordability and cultural acceptability.

13

Heterogeneity in farmers' preferences and willingness to pay for improved climate-resilient enset varieties in Ethiopia: Evidence from a choice experiment and machine learning analysis

Tesfaye Etensa Guta

Addis Ababa University, Ethiopia

Enset (Ensete ventricosum), a cornerstone of Ethiopia's climate-resilient agriculture, faces persistent challenges including bacterial wilt, suboptimal yields under current management practices, limited market incentives, recurrent droughts, and the inherent long maturation period. Despite its vital role in food security and sustainability, the crop remains underutilized and policy-neglected. Its economic value and adoption potential are poorly understood, underscoring the need for rigorous economic valuation to inform targeted and sustainable interventions. This study investigates rural households' preferences and willingness to pay for improved enset varieties using a combination of contingent valuation and choice experiment methods, based on primary survey data from 520 randomly selected households across Oromia and Central Ethiopia regions. The contingent valuation employed a double-bounded elicitation format, while the discrete choice experiment captured trade-offs among six key varietal attributes using a D-efficient fractional factorial design generated in JMP Pro 18 (SAS) and organized into three blocks. Data were analyzed using random parameters logit, generalized multinomial logit, endogenous attribute attendance and latent class models, while Random Forests machine learning served as robustness checks. Results reveal substantial heterogeneity in farmer preferences, with resistance to Enset Bacterial Wilt (EBW), early maturity, yield stability, and carbon sequestration strongly driving adoption, while long-term traits such as drought resilience and late-maturing varieties played a secondary role. Marginal WTP estimates indicate high valuation of EBW resistance and early maturity, moderate valuation of yield and carbon sequestration, and insignificant valuation of drought tolerance. Affordability constraints may limit adoption, particularly among resource-constrained households. The latent class model revealed three distinct farmer segments: risk-averse and productivity-oriented, moderate adopters, and environmentally selective. Policy implications include targeted subsidies, payments for ecosystem services, and climate finance mechanisms to incentivize late-maturing and climate-smart traits, coupled with strengthened extension services and institutional support. Recognizing and addressing trade-offs between immediate household priorities and long-term ecological benefits is essential for scaling improved enset varieties, enhancing food security, and promoting sustainable, climate-resilient agricultural systems.

Heterogeneity in farmers' preferences and willingness to pay for improved climate-resilient “enset” varieties in Ethiopia

TSARA Sciences Days 2026
Theme: Agroecological transition & sustainable food systems
Presenter: Tesfaye Etensa (PhD Fellow, Addis Ababa University)

Background and motivation

- Enset (false banana) is a core indigenous crop in Ethiopia
- Cultivated for over 10,000 years and grown in mid - to high-altitude areas
- Provides kocho, bulla, and amicho, supporting the livelihoods of over 35 million Ethiopians
- Provides year-round food, drought tolerance, and long -term storage
- Delivers key ecosystem services: soil conservation and carbon sequestration
- Historically buffered households during droughts and famines
- Enset is a strategic but underutilized climate-resilient crop

1st science days Etensa Tesfaye
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January 13, 2026January 13, 2026 Valuing improved enset varieties for sustainable food systems

Background and motivation….

Why enset matters for climate and food security?

- Cultivated on >500,000 hectares
- Sustains higher population densities than cereal systems
- Perennial system with low external input requirements
- Strong alignment with SDG 2 (Zero Hunger) and SDG 13 (Climate Action)

1st science days Etensa Tesfaye
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Background and motivation….

The paradox – high Potential, low policy attention

- Despite its advantages, enset faces:
- Limited policy prioritization
- Minimal inclusion in agricultural investment strategies
- Bias toward cereals and short-term commercial crops
- Result in a critical climate buffer is being eroded

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January 13, 2026 Valuing improved enset varieties for sustainable food systems

Background and motivation….

Major constraints facing enset systems

- Enset Bacterial Wilt (EBW) causes complete crop loss
- Long maturation period (4–12 years)
- High labor requirements and low market incentives
- Limited extension and institutional support

Background and motivation….

Emerging threats

- Climate variability and recurrent droughts
- Land scarcity and population pressure
- Policy neglect and weak innovation systems
- Results declining resilience of enset-based systems

Policy and evidence gaps

- ➢Enset remains marginal in agricultural policy frameworks
- ➢Research dominated by agronomic and ecological studies
- ➢Limited evidence on farmer preferences and willingness to pay
- ➢Constrains demand-driven breeding and climate finance design

Study objective and contribution

- oEstimate farmers' preferences for improvedenset varieties
- oQuantify willingness to pay for key varietal traits
- oCapture heterogeneity in adoption behavior
- oInform climate-smart and agroecological investments

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January 13, 2026 Valuing improved enset varieties for sustainable food systems

Data and methods

- Survey of 520 smallholder households
- Oromia and Central Ethiopia regions
- Discrete Choice Experiment + Double-bounded CV
- Random parameters logit, generalized multinomial logit, and, Latent Class; Random Forest for robustness

Key findings

✓Strong preference for EBW resistance

✓Early maturity and yield stability highly valued

✓Carbon sequestration recognized as a co-benefit

✓Substantial heterogeneity across farmer groups

Implications for agroecological transition

- ➢Improved enset varieties reduce production risk
- ➢Demand-driven innovation accelerates adoption
- ➢Entry point for carbon finance and PES mechanisms
- ➢Strengthens sustainable food systems

Conclusion and way forward

- Enset is a high-value but undervalued climate-resilient crop
- Economic valuation is critical for effective policy design
- Align breeding, extension, and incentives (like carbon financing) with farmer demand
- Opportunity for TSARA-aligned collaborative research

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January 13, 2026 Valuing improved enset varieties for sustainable food systems

Temporary Migration and Household Food Consumption in Nigeria

Adrien Gosselin-Pali & Elodie Maître d'Hôtel

CRED, University of Namur, Belgium & Cirad, France

In West Africa, households often rely on temporary internal migration as a livelihood strategy. In Nigeria specifically, about one in two people has migrated within the country at least once in their life. These movements are predominantly rural-urban, but also include rural-rural flows. However, the impacts of such temporary migration on sending households remain understudied. This paper examines how short-term internal migration in Nigeria affects food consumption in the household of origin. We distinguish between households whose migrant is still away and those whose migrant has recently returned.

We use data from the Nigeria General Household Survey Panel (LSMS-ISA), a nationally representative longitudinal survey that includes detailed migration modules. To capture short-term temporary migration, which is often seasonal and cyclical, we rely on the module that records individuals' migration episodes over the preceding twelve months. Household food consumption is measured using composite indicators of dietary diversity and quality (HDDS, FCS, and FVS). In addition, we construct measures of consumption frequency and quantities at the food group level, as well as quantities of individual food items, in order to estimate total food consumption and share of processed foods. To estimate the effects of temporary migration on households' food consumption, we implement an inverse probability weighted regression adjustment (IPWRA) approach.

We find positive effects of migration for households whose migrants have returned, whereas households whose migrants are still away show no comparable improvement in food consumption. Specifically, among households with returning migrants, dietary quality scores increase by up to 8 percent. Similarly, the weekly consumption frequency of a variety of foods rises by up to 30 percent. These increases concern the consumption frequency of fruits, vegetables, condiments, and milk, but also fats and sweets. By contrast, the effects on food quantities by food group are limited. Moreover, both the share and the quantity of processed food consumption increase in the context of return migration. While these patterns are consistent with a short-run income or liquidity effect upon return, we do not rule out the role of social remittances and the transmission of new food habits from migrants to origin households.

This study connects the migration literature with work on changing food practices and the nutrition transition in sub-Saharan Africa and shows that temporary migration can be one of its drivers. In particular, upon return, migrants themselves may exert a positive influence on households' dietary quality, while also contributing to higher consumption of processed foods, fats and sweets.

Motivation

- Research often focus international migration.
- Yet, **internal migration** is more prevalent. Globally, 1 in 10 people are internal migrants (UNDP, 2009). In Nigeria, 60% of women and 50% of men have moved within the country at least once (Poufon et al., 2023).
- Research often focus on migrants themselves and not on their households of origin.
- Yet, temporary migration as livelihood strategy, especially for rural households

Literature and contribution

- Internal migration and diets of households at origin = mostly positive results on food security, trough remittances.
- No evidence on heterogeneity between households where the migrant is still away and the migrant has returned. In both cases, remittances at work. When returned, potential effect of acculturation.
- No evidence on specific impact on diets quality, trough different food groups consumption and processed versus unprocessed food items consumption.

Overarching question

What is the impact of temporary internal migration on the diets of households at origin, depending on whether the migrant is still away or has returned?

Context of internal migration in Nigeria

- **Rural-urban migration** = dominant form ⇒ **over 60 %** of internal moves (IMS, 2010).
  But rural-rural migration = also important (e.g., seasonal workers).
- Diverse drivers, but **economic reasons** = central (non-farm jobs, higher earnings, etc.)
- Mobility is often **circular and seasonal** : short-term work off-season and return for planting or harvest ⇒ **temporary/recurrent moves with regular returns** .
- ⇒ Nigeria = relevant context for temporary internal migration and its effects on the household of origin.

Data and identification of migration

- Data:
  - **LSMS - ISA Nigeria: General Household Survey - Panel .**
  - **Wave 4 (2018 - 2019)** and **Wave 5 (2023 - 2024)** .
- Definition of temporary internal migration (Wave 5, post-planting):
  - Module: *Migration in the last 12 months.*
  - Temporary migration: a household member lived away from the household for **more than one month** in the last 12 months.
  - Status at interview: **still away** or **returned** .

Treatment and control groups

Households with no temporary migrant (control)

No household member lived away from the household location for more than 1 month in the last 12 months.

Households with a migrant currently away (treatment 1)

At least one member lived away for more than 1 month in the last 12 months and **is still away** at interview.

Households with a returned migrant (treatment 2)

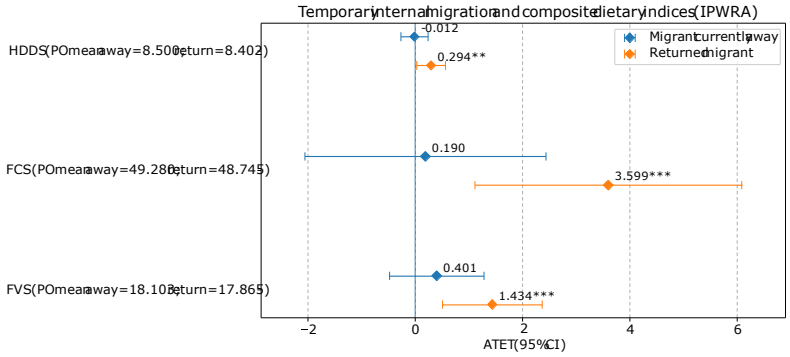
At least one member lived away for more than 1 month in the last 12 months and **has returned** by the time of the interview.

	Sample	Treated (N, %)	Control (N, %)
HH still - away	4,442	250 (5.6%)	4,192 (94.4%)
HH returned	4,413	221 (5.0%)	4,192 (95.0%)

Outcomes: household food consumption and diet

- Outcomes measured over the **last 7 days** (Wave 5 post-planting).
- Composite indicators (diet diversity, quality and variety)
  - **HDDS** (0–12): *dietary diversity* at the food-group level. Number of food groups consumed at least once.
  - **FCS** (0–112): *diet quality/adequacy*. Sum of days of consumption across food groups, weighted by nutritional importance.
  - **FVS** : *item-level variety*. Number of distinct food items consumed at least once.
- Food groups and processing
  - **Days of consumption by food group** .
  - **Processed vs. unprocessed** : quantities processed and unprocessed, and **share processed** (stand and per adult equiv).

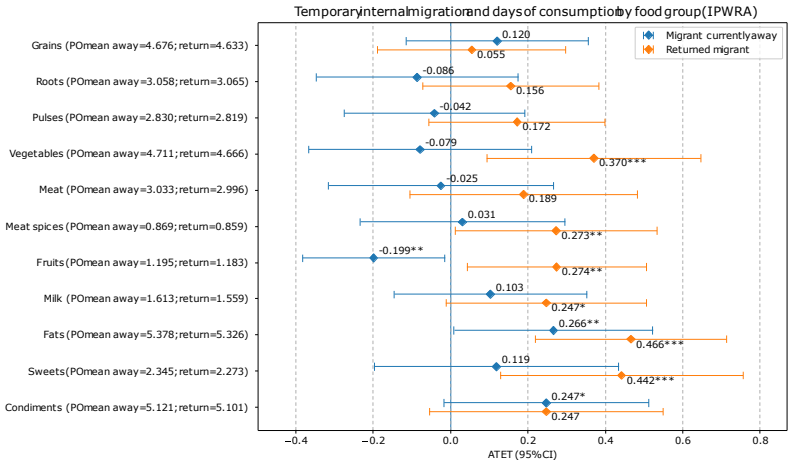
Results – composite dietary indicators



Notes: IPWRA ATET with 95% CI. Standard errors clustered at the LGA level.

⇒ Improvements in households' diets mainly upon return
⇒ higher dietary diversity and variety

Results - days of consumption by food group



Notes: IPWRA ATET with 95% CI. Standard errors clustered at the LGA level.

⇒ Upon return: more days consuming fresh food (fruits, vegetables), meat spices or fats

⇒ BUT ALSO more days with sugar products.

Results - processed/unprocessed food

Table: Treatment effects from IPWRA - food processing quantity and share

	Quantity consumed Unprocessed	Processed	Share consumed Processed
Household with a migrant currently away			
ATET	-0.777*	-0.052	0.004
	(0.462)	(0.053)	(0.005)
POmean	7.099***	0.536***	0.076***
	(0.192)	(0.029)	(0.004)
Observations	4,442	4,442	4,442
Household with a returned migrant			
ATET	0.620	0.159***	0.012**
	(0.443)	(0.052)	(0.005)
POmean	7.431***	0.550***	0.077***
	(0.233)	(0.028)	(0.003)
Observations	4,413	4,413	4,413

Notes: Standard errors clustered at the LGA level in parentheses. The comparison group is household without a migrant. All specifications include the same set of pre-treatment covariates (Wave 4) in both the treatment and outcome models. *POmean* refers to the expected value for non-treated units, conditional on covariates. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Why are effects concentrated at return?

- **Main finding:** temporary migration affects household diets mainly once the **migrant has returned to the household of origin** .
- Two potential mechanisms:
  - **Income/liquidity** : return brings resources (savings, additional income, labor force) (Stark and Lucas, 1988; Azzarri and Zezza, 2011).
  - **Social remittances** : return brings back food preferences, norms, or routines acquired at destination (Levitt, 1998; Levitt and Lamba-Nieves, 2011).

Thank you for your attention!

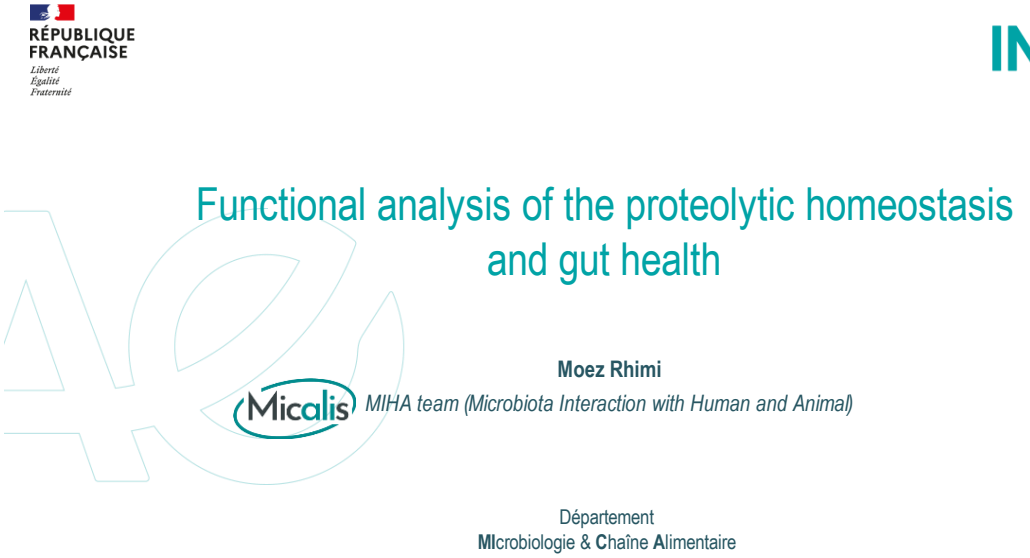
- Research question : What is the effect of temporary internal migration on household diets in Nigeria and does it differ for still-away vs returned migrants?
- Data : Nigeria GHS-Panel (LSMS-ISA) .
- Method : IPWRA (and double machine learning) .
- Main finding : Dietary impacts are concentrated upon return (higher diet diversity/variety and more frequent consumption across several food groups) .
- Interpretation : Return combines resources (income/liquidity) and new food habits brought back from destination .

A Glance at African foods and their effects in Inflammatory Bowel Diseases

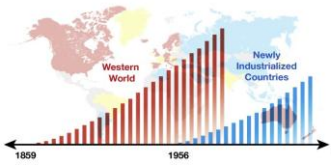
Moez Rhimi

INRAE, France

Since the emergence of microbiome research over the past decades, many studies have focused on understanding the factors that shape the human gut commensal microbiota. Among the multiple factors involved, diet appears to be a key determinant of the structure and function of the intestinal microbial community. In the context of chronic intestinal inflammation, dietary habits and certain food components have been identified as important modulators of inflammatory responses, notably by increasing the abundance of beneficial microbes that produce anti-inflammatory effectors. In our study, we show that traditional African foods exhibit distinct proteolytic profiles capable of modulating proteolytic homeostasis, a key factor in maintaining gut health.



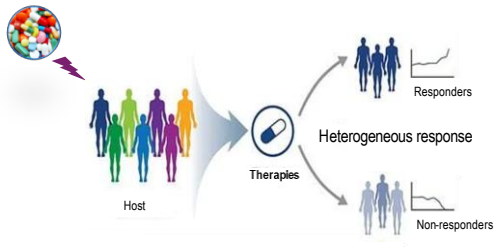
IBD: a major public health problem!



(Kaplan GG, Ng SC, Gastroenterology, 2017)

- 3 million deaths worldwide / year
- Increasing incidence
- No curative treatment

(Alatab et al., The Lancet Gastro. & Hepatol., 2020)





Holobiont= host + microbiome

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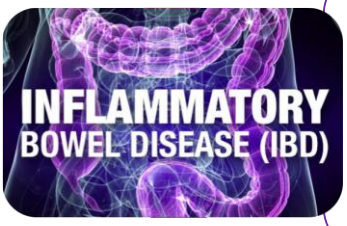
Functional dysregulation in IBD



HOLOBIONT DYSFUNCTION

- ↑ *Actinobacteria* & *Proteobacteria* in the gut microbiota
- ↑↑ Pro-inflammatory cytokines
- ↑ Tryptophan metabolism
- ↓ Bile acids metabolism by the microbiota
- ↑↑ **Proteases**

(Lloyd-Price Jet al. Nature. 2019 ; Neurath., Friedrich et al. Immunity. 2019 , Kriaa et al., FASEB J, 2019, Mariaule et al., IJMS, 2021, Mkaouar et al., IJMS, 2021)

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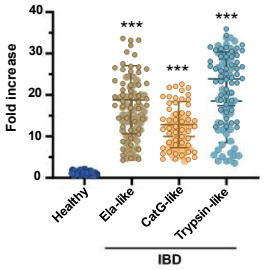
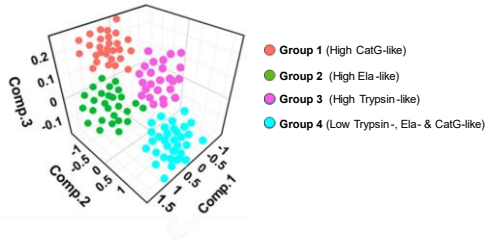
What is the variability of protease activities in IBD patients?



IBD (n =600)
Healthy (n = 300)
Multicentric cohort (Africa & Europe)







✓ We identified 4 groups

⇢ Proteolytic activities allow the stratification of the IBD patients

⇢ Association with severity, response to treatment?

Food involvement in proteolytic homeostasis

What is the importance of food for proteolytic homeostasis?
Can it be a lever to modulate gut proteolytic activity?



Diet-RestorPro

- ✓ Limited knowledge on food – proteolytic activity – host
- ✓ Foods are sources of proteases and anti-proteases
  Salim et al F. Nut. 2023; Ferreira et al Plants 2023 & 2024
- ✓ Diet is a main modulator of the microbiome
  Ross et al Nat. Rev. Hepatol. Gastro. 2024
- ✓ IBD treatments based on nutritional interventions are of little benefit
  Mariaule et al, Gut, under review



Traditional EU & African foods

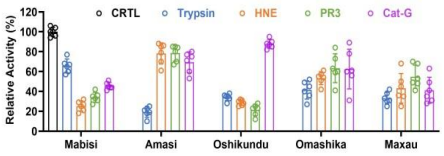


Novel foods fermented by synthetic communities

Traditional African foods:

⇢ Source of antiproteases

⇢ Various inhibition profiles against proteases involved in IBD



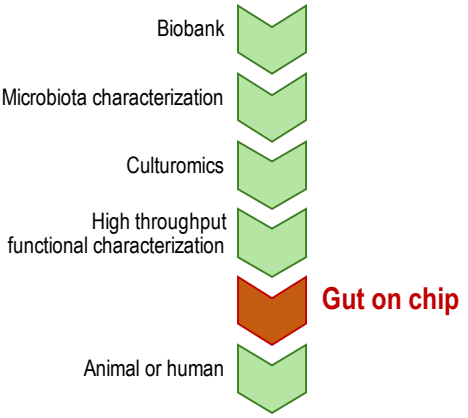
DOMINO

Fermented foods:

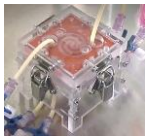
⇢ Design of tailored microbial consortia for fermentation

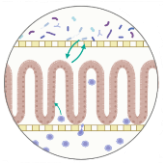
⇢ Develop new fermented foods for a healthy nutritional transition from animal to plant-based products

How we can analyze the variability of protease activities in IBD patients?



Gut-on-chip Core Facility (GCF)





- ✓ Screening of probiotics, xenobiotics and fermented food impact on the holobiont
- ✓ Determination of the molecular basis of their mode of action

anr® RestorPro Diet-RestorPro DOMINO MICAFRICA

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Surveys on breastfeeding practices in the southeastern Democratic Republic of the Congo

Francisca Ngenda Kabombo

Nantes Université, INRAE, France

Université Nouveaux Horizons, DRC

The World Health Organization (WHO) recommends exclusive breastfeeding for up to 6 months and continued breastfeeding up to 2 years, due to its benefits for both infant and maternal health. Despite these recommendations, exclusive breastfeeding rates remain low globally (13% in France at 4 months and 53% in the Democratic Republic of the Congo (DRC) at 5 months). One of the main reasons for early cessation of breastfeeding is the mother's perception of insufficient breast milk. To compensate for low milk supply, some breastfeeding mothers use galactagogue plants (plants that stimulate breast milk production). In the DRC, there are no specific data on the use of these plants.

I am currently conducting surveys in the southeastern DRC among breastfeeding mothers with infants under six months of age. This work focuses on breastfeeding difficulties (complete absence of breast milk, delayed milk flow or low milk production, and breastfeeding pain). The questionnaire is designed to collect information on their health, diet, practices and breastfeeding-related difficulties, as well as their knowledge of galactagogue plants. The surveys were conducted in Swahili or French.

To date, 65 mothers have responded: 61 (94%) in urban settings (public hospitals, private hospitals, and a mission hospital) and 4 (6%) in peri-urban areas.

During the first seven days after delivery, infant feeding practices were highly diverse, with a majority of exclusive breastfeeding (60.9%), followed by mixed breastfeeding (14.1%), infant formula feeding (12.5%), predominant breastfeeding (6.3%), and water consumption or glucose perfusion (6.3%).

Forty-two mothers experienced delayed initiation of breastfeeding. Parity did not influence this delay ($p=0.65$), whereas age had a significant negative effect ($p=0.0001$). Many mothers modified their diets during lactation, increasing consumption of commonly used vegetables in the DRC (cassava leaves, pumpkin leaves, amaranth, and cabbage, often prepared with peanut powder). A dietary marker of the lactation period is the consumption of red tea, which is positively associated ($p<0.0001$) with delayed initiation of breastfeeding. Forty-nine mothers received advice on breastfeeding practices. These recommendations came from healthcare workers (39 out of 65 mothers), family members (7 out of 65), or friends and acquaintances (3 out of 65). Advice from healthcare professionals did not affect delayed initiation of breastfeeding ($p=0.88$).

Most of the surveyed mothers were unaware of the existence of galactagogue plants (61 out of 65). However, such plants do exist in southeastern DRC and are better known by traditional healers, who are also part of this study. To date, I have recorded 10 galactagogue plants, of which only two have been identified: one from the genus *Drimia* and the other from the genus *Phyllanthus*. The preliminary results highlight the importance of dietary practices and local knowledge in supporting breastfeeding. Field surveys are ongoing, and the study will be extended to a more detailed botanical characterization of galactagogue plants as well as an assessment of their potential physiological effects on lactation.

Surveys on breastfeeding practices in the south-east of the Democratic Republic of Congo

Presented by Francisca NGENDA KABOMBO

Supervisors: Khadija OUGUERRAM
Clair-Yves BOQUIEN
Paul MOBINZO

Breastfeeding (BF) is beneficial for baby's and mother's health



BF : feeding newborns their mother's milk

World Health Organization

Exclusive BF for 6 months ✚ **Additional BF up to 2 years**

In babies

- ↓ Mortality
- ↓ Gastrointestinal infections
- ↓ Respiratory infections

(Prentice, 2022)

In mothers

- ➢ Breast cancer prevention
- ➢ Ovarian cancer prevention
- ➢ T2D Prevention

(Chantry et al., 2015)

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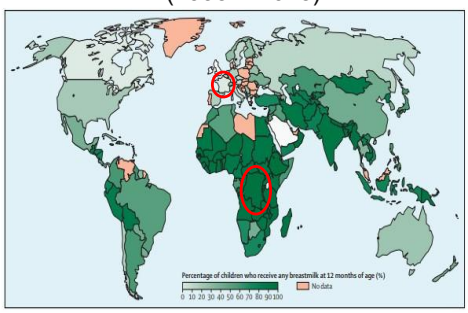
BF is a global challenge

Worldwide distribution of BF rate (1995 – 2013)



(*Victora, 2016*)

Country	Period	Age	% EBF
France	2024	4 months	15
[illegible]	2017-2018	5 months	53,5

(*Salanave et al., 2024; INS, 2019*)

Strategies to promote BF

- ✓ Educating mothers
- ✓ Supporting mothers throughout BF
  - Identifying the causes of early cessation
  - Suggesting solutions
  - Recommending appropriate diets

(*Lassi et al., 2020*)

Causes of early cession of BF in DRC :

- The BF mother's lack of confidence in her ability to breastfeed
- Lack of planning regarding the duration of EBF
- BF problems during the first week
- Low level of knowledge about breastfeeding

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The use of plants as galactagogues is common during BF

Galactagogue = food or medicine that increases breast milk production

- Plant-based galactagogues are:
  - very numerous
  - different from diets
  - widely used (60% of Australian breastfeeding mothers)
  - parts of plants



Fenugreek (*Trigonella foenum-graecum*)



Moringa (*Moringa oleifera*)



Shatavari (*Asparagus racemosus*)



Ginger (*Zingiber officinale*)



Banana flower (*Musa paradisiaca*)

  - consumed in various forms :
    - herbal tea, infusion, capsule, etc.
  - consumed in varying doses and frequencies

Yasin *et al.*, 2024 ; McBride *et al.*, 2022 ; Kwan and Abdul -Rahman, 2021 ; Foong *et al.* 2020

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Research question

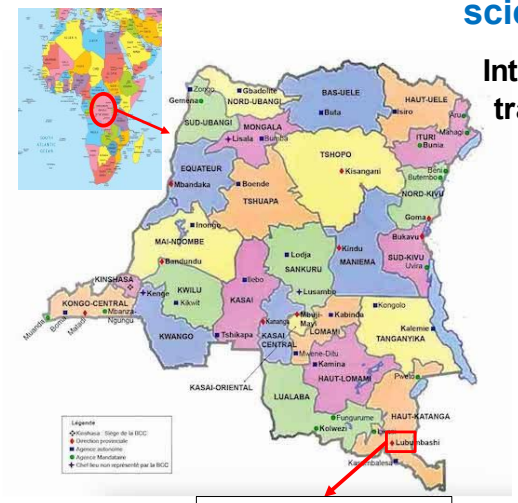
How do BF women solve problems related to BF in south-eastern DRC?

Objectives

1. Identify the difficulties encountered by mothers during BF.
2. Assess BF mothers' knowledge of BF practices.
3. Identify the herbal galactagogues they use to overcome BF problems.

TSARA

The DRC is said to have galactagogue plants that are less known and whose effectiveness has not been the subject of scientific study



Lubumbashi city
Surrounding villages

Interview survey of traditional healers

Questionnaire surveys of BF mothers (n=120)

In French and in local languages (Kiswahili, Bemba, Luba)

Health data,
Diet data,
BF practices,
Information on galactagogues

Plant identification

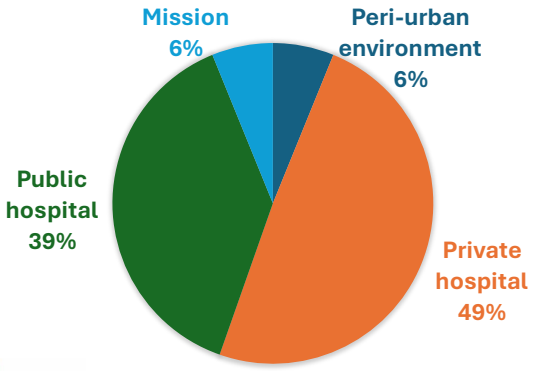
Bibliography on plant

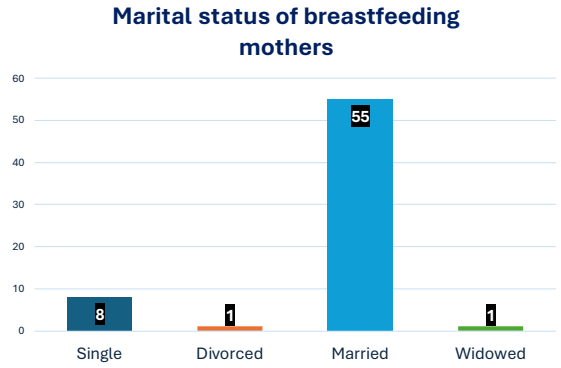
TSARA

Part 1 : Surveys of BF mothers

1. The majority of BF mothers (n=65) were met at the hospital and most of them are married

➢94% urban settings, 6% peri -urban.





TSARA

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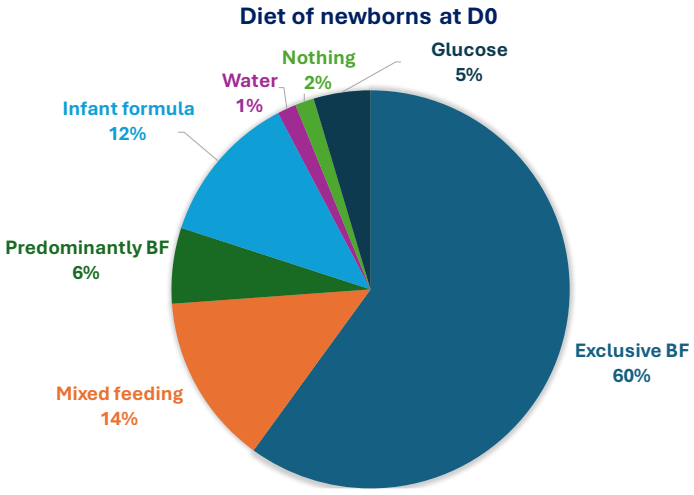
2. The diets used to feed newborns varied greatly in the hours following delivery



TSARA

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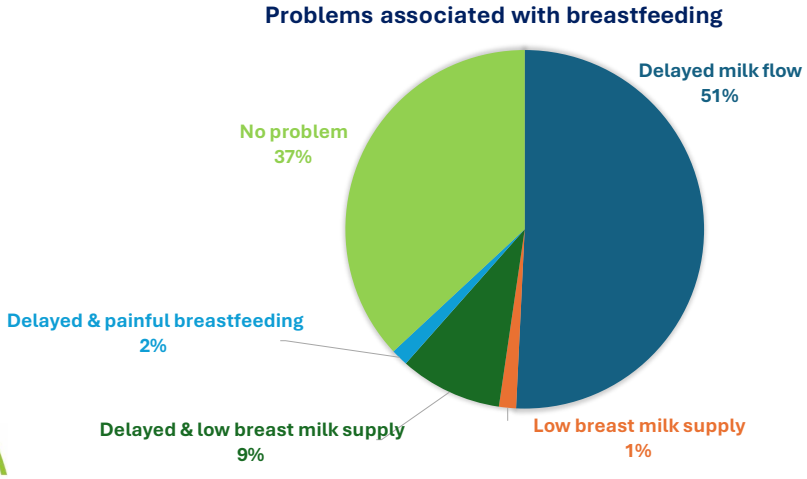
3. A large proportion of BF mothers (63%) experienced difficulties BF

- Difficulties associated with BF are very varied
- Most mothers experienced a delay in breast milk production



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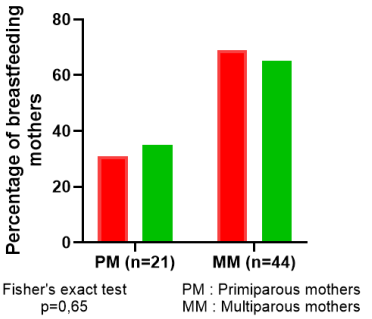
4. The majority of mothers interviewed (42 out of 65) experienced a delay in initiating BF

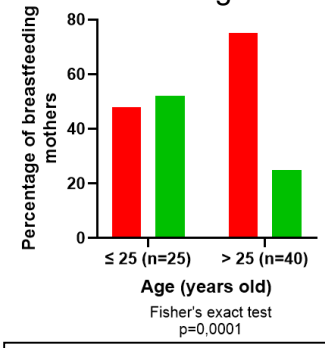
Association between delayed initiation of BF and :

a. Parity



No association

b. Mothers' age



Negative association

Delayed initiation of BF
No delay in initiating BF

TSARA

5. The majority of BF mothers changed their diet after giving birth

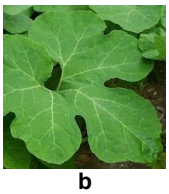
➢ To increase the production of breast milk, mothers say they drink **red tea** and eat :

1. Soaked peanuts
2. Raw Cassava
3. Vegetables cooked with peanut powder :
   a. Cassava leaves
   b. Pumpkin leaves
   c. Amaranth
   d. Cabbage


1


2


a


b


c


d

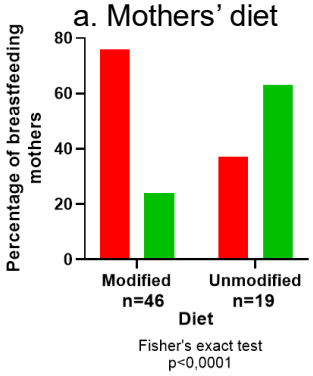
Majority of BF mothers unaware of galactagogue plants (61 out of 65)

TSARA

6. Delayed milk flow prompts mothers to change their diets

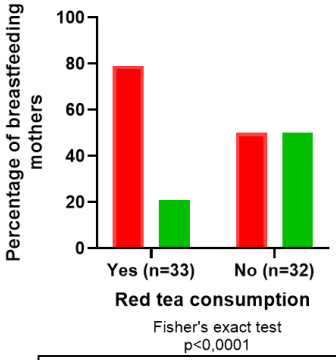
Association between delayed initiation of BF and :

a. Mothers' diet



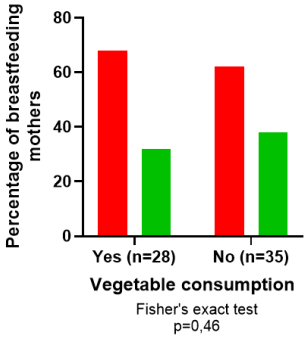
Positive association

b. Red tea consumption



Positive association

c. Vegetable consumption

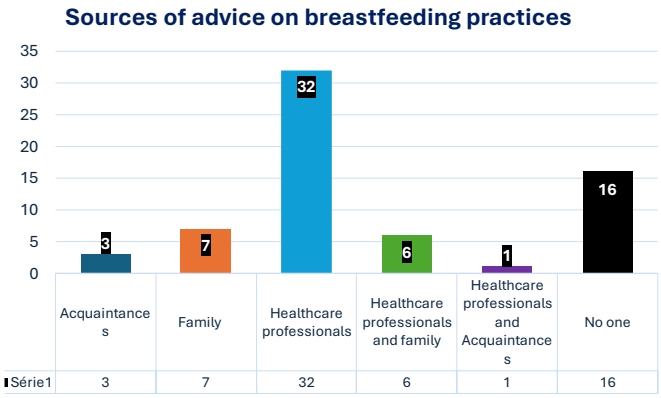


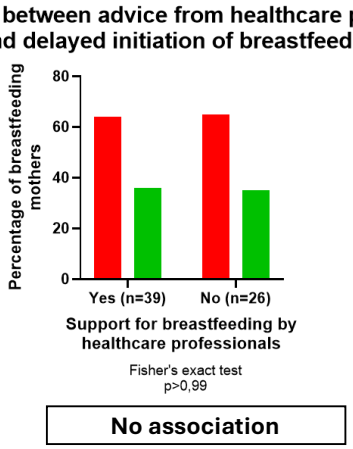
No association

Delayed initiation of BF
No delay in initiating BF

TSARA

7. Support for BF comes from various sources and that of healthcare professionals does not influence the delay in initiating BF





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Conclusion

Initial results show that my study highlights the importance of dietary practices and local knowledge in supporting BF.

Outlook

- Cotinue with field surveys
- Extend the study to include :
  - a more precise botanical characterisation of galactagogue plants
  - an assessment of their potential physiological effects on lactation

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Many thanks to :

- UNH for the technical support
- TSARA for the financial support
- BF mothers for answering to my questionnaire

Thank you for your attention.

Influence of Household Power Relations on Dietary Diversity and Food Access for Pregnant Women, Lactating Mothers, and Under-Five Children in Akaki Kality Sub-city, Addis Ababa

Elleni Tamire Taddesse

Food Security and Development Studies, Addis Ababa University, Addis Ababa, Ethiopia

Adequate dietary diversity is essential during pregnancy, lactation, and early childhood to prevent nutrient deficiencies and meet high energy demands. This cross-sectional study included 504 households with pregnant women, lactating mothers, and under five children in Akaki Kality sub city, Addis Ababa, using validated scales to examine food security, dietary diversity, and intrahousehold power dynamics among these vulnerable members households. Results indicated 92.7% households experienced food insecurity, with cereal-dominated diets. Additionally, wives were more responsible for food and consumable related tasks. Regression analysis revealed that increased dietary diversity was associated with higher employment (ME= 0.033), increased wealth (ME= 0.217), presence of pregnant women (β= 0.127), and child illness (ME=0.048). Conversely, decreased dietary diversity was linked to household member illness (ME= –0.042), urban gardening participation of wife (ME= –0.057), and wife dominated decision on food prepared for lunch (ME= –0.039). Furthermore, greater food insecurity was correlated with larger household size (β= 0.123), household member illness (ME= –0.12), urban gardening participation by wife (ME= –0.155), and wife ownership of assets (ME= –0.143). Improved food security was tied to higher wealth (ME= 0.559), household head employment (ME= 0.083), positive maternal attitude about childcare (β= –0.1), maternal nutrition knowledge (β= –1.969), and equal decision-making on consumables purchase (ME= 0.1). Conclusions: Enhancing living standards, employment opportunities and family planning are critical for improving food and nutrition security in this vulnerable population. Crucially, empowering women only at household level did not promote household food access and dietary quality. Multi-level women empowerment at community and national levels is needed along economic interventions.

Influence of Household Power Relations on Dietary Diversity and Food Access for Pregnant Women, Lactating Mothers, and Under-Five Children in Akaki Kality Sub-city, Addis Ababa

Prepared by : Taddesse Elleni Tamire

15/1/2026

Addis Ababa, Ethiopia

Introduction

- Food security, which involves consistent access to sufficient, safe, and nutritious food is fundamental for optimal health and an active life.
- In addition, adequate dietary diversity is essential during pregnancy, lactation, and early childhood to prevent nutrient deficiencies and meet high energy demands.
- Intrahousehold power relationship significantly impact dietary diversity and food security by influencing how food is accessed, allocated, and utilized
- Globally, especially in Africa, achieving food security and acceptable dietary diversity remains a significant challenge.

Methods

- This cross-sectional study was conducted in Akaki Kality Sub city, Addis Ababa, Ethiopia.
- A multistage cluster probability sampling technique was used for sample selection.
- The Household Food Insecurity Access Scale (HFIAS) was used to measure household food security.
- The Household Dietary Diversity Score (HDDS) was used to assess dietary diversity.
- Intrahousehold power relations questions explored the participation of various household members in decision-making concerning food purchases, food preparation, and resource allocation.

Results

- HFIAS indicated that 92.7% of households experienced food insecurity
- furthermore, the analysis of 24-hour food consumption data revealed that cereals were the dominant food group consumed by 92.4% of the households.
- In addition wives were more responsible for food and consumable related tasks

Continued

- Regression output indicated that, higher employment and increased wealth, were associated with intake of well diversified diet, this was linked to the financial independence from the job.
- Similarly presence of pregnant women, and child illness were related to intake of diversified food.
- On the contrary, urban gardening participation of the wife and wife dominated decision on food preparation were associated with decreased dietary diversity likely due to time and financial constraints.
- Some studies indicated that women's decision-making power does not always translate to better diets, since fathers are privileged to eat before them and receive complete and better food, even if the women have better decision making.

Continued

- With similar analysis household member illness had increased household food insecurity, the influence of disease and disability on food insecurity was also reflected.
- In addition urban gardening participation by wife and wife ownership of assets have aggravated food insecurity, explained by increased stress of paid and unpaid jobs at home and outside of home among women.
- A surge in household food insecurity was additionally correlated with larger household size.

➨ On the other hand, improved food security linked to higher wealth, household head employment, positive maternal attitude about childcare and better maternal nutrition knowledge.

➨ equal decision making on consumables purchase was associated with better household food security as well.

Genetic and phylogeographic characterization of H9N2 avian influenza viruses circulating in Mali and dispersal dynamics across Western Africa

Idrissa Nonmon Sanogo

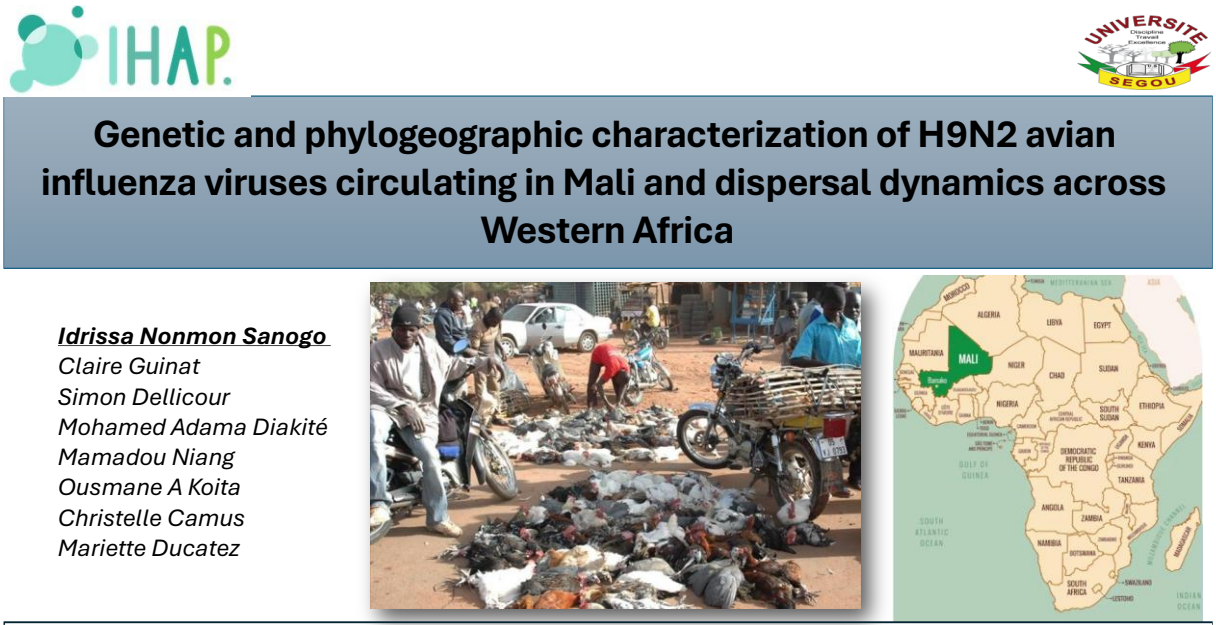
Université de Ségou, Mali

Avian influenza viruses (AIVs) of the H9N2 subtype have become endemic in domestic poultry across Western Africa since their first detection in 2017. However, their genetic diversity, evolutionary history, and regional spread remain poorly characterized, particularly in Mali, where surveillance efforts have been limited.

Live bird markets (LBMs) in Mali play a substantial role in the emergence and spread of new AIV strains, as various species of domestic birds from different regions are brought together (Molia et al. 2016). Risk factors associated with the presence of AIVs, such as poor sanitary conditions and improper disposal of dead birds, have been reported in the majority of Malian LBMs (Molia et al. 2016). Therefore, active surveillance in LBMs is crucial for understanding the genetic characteristics, geographic origins, and dispersal patterns of the circulating H9N2 viruses in Mali.

In this study, we conducted a comprehensive genomic characterization of H9N2 viruses collected from LBMs in Mali during 2021 - 2022. Additionally, we performed a continuous phylogeographic analysis to unravel the dispersal history of H9N2 lineages between Northern and Western Africa. Our results indicate that the H9N2 virus detected in Mali belongs to the G1 lineage and harbors multiple molecular markers associated with increased potential for zoonotic transmission and virulence. Additionally, we demonstrated that a single significant long-distance lineage dispersal event of the H9N2 virus to Western Africa likely originated from Morocco in 2015, shaping the westward diffusion and subsequent regional dispersal of the H9N2 virus.

These findings provide the first genomic and phylogeographic analysis of H9N2 viruses circulating in Mali, and highlight the importance of long-term surveillance of H9N2 in poultry populations across Western Africa to improve understanding of virus evolution and develop effective strategies to prevent potential zoonotic AIV strain emergence.



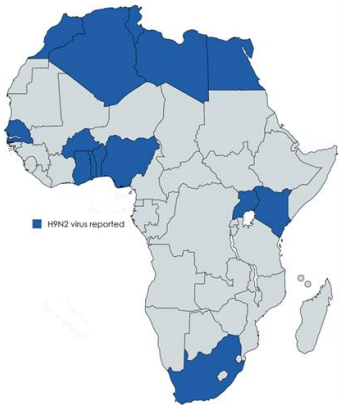
H9N2 virus circulation in West Africa

H9N2 is the most widespread avian influenza subtype in poultry worldwide

Despite being low pathogenic, H9N2 causes substantial economic losses and has zoonotic potential

H9N2 virus has circulated in West Africa since 2017, but its genetic diversity and spread remain poorly understood

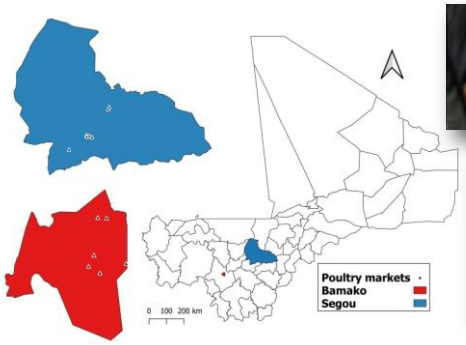
Circulation of H9N2 in Africa between 2006 - 2022



Comprehensive genetic characterization of H9N2 viruses in live bird markets in Mali and phylogeographic analysis of H9N2 in West Africa

Experimental and analytical methods

***519 oropharyngeal swabs** collected from 13 poultry markets in Bamako and Segou between 2021 and 2022*







Samples tested in pools of 5 at the LCV in Bamako by qRT-PCR targeting the M gene



Positive pools were shipped to IHAP Toulouse and tested individually by qRT-PCR targeting the M and HA genes.

Virus isolation and full -genome sequencing for selected isolates

Phylogenetic and Continuous phylogeographic analysis of H9N2 sequences between 2011 - 2022 in North and West Africa

Countries	# HA of sequences used
Algeria	4
Benin	10
Ghana	4
Mali	2
Morocco	33
Nigeria	16
Senegal	1
Togo	3
Tunisia	5
Total	**78**

Genetic characteristics of H9N2 viruses in Mali

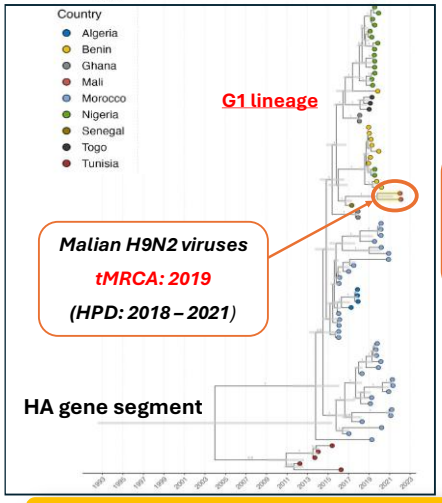
- **84 positive samples out of 519**: **Positivity rate of 16%** (Bamako: **17%**; Ségou: **4.5%**)
- **Whole genome sequences for seven H9N2 viruses** generated
- **High nucleotide sequence identity** (95.8–100%) among Malian H9N2 viruses across all eight gene segments

H9N2 Sequences – Mali
A/chicken/Mali/22-A-01-113/2022
A/chicken/Mali/22-A-02-123/2022
A/chicken/Mali/22-A-02-128/2022
A/chicken/Mali/22-A-02-139/2022
A/chicken/Mali/22-A-02-143/2022
A/chicken/Mali/22-A-02-152/2022
A/chicken/Mali/22-A-02-158/2022

Molecular markers associated with zoonotic potential and virulence

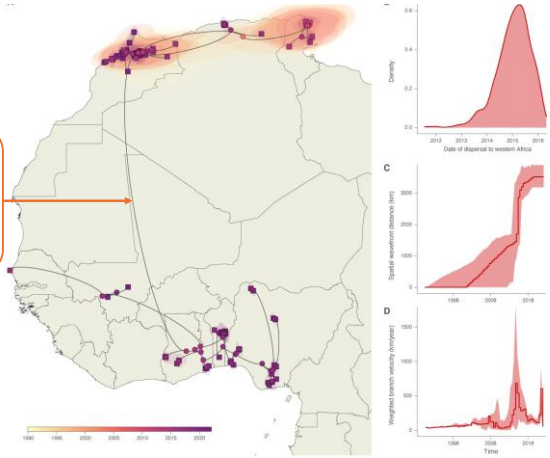
Gene	Mutation	Virus H9N2 du Mali 113	123	128	139	143	152	158	Fonctions
HA	I155T	T	T	T	T	T	T	T	Binding of avian influenza viruses to mammalian receptors
	Q226L	L	L	L	L	L	L	L	Affinity of AIVs for human-type receptors
	Clivage site	RSNR	RSRR	RSNR	RSRR	RSRR	RSRR	RSRR	
PB2	M185I	I	I	I	I	I	I	I	Mammalian host–specific marker
PB1	D3V	V	V	V	V	V	V	V	Increased virulence in mammalian cells
PA	A515T	T	T	T	T	T	T	T	Enhanced polymerase activity and increased virulence
NP	E372D	D	D	D	D	D	D	D	Detected in AIVs isolated from humans
M1	N30D	D	D	D	D	D	D	D	Increased virulence in mice
	T215A	A	A	A	A	A	A	A	Increased virulence in mice
M2	S31N	N	N	N	N	N	N	N	Résistance à l'amantadine
NS1	P42S	S	S	S	S	S	S	S	Increased virulence in mice
	F103L	V	L	V	L	L	I	V	Enhanced replication and virulence

MCC tree and tMRCA of H9N2 viruses



Phylogeographic reconstructions of H9N2 viruses in West Africa

A single long-distance dispersal event from Morocco to West Africa in 2015, followed by regional spread of H9N2 lineages



Together, our results provide new insights into the evolution and spread of H9N2 in West Africa and emphasize the importance of regional genomic surveillance of avian influenza viruses

Valorization of Moroccan microbial resources for applications in human nutrition and health through a sustainable collaboration between the MICALIS Institute (INRAE, France) and the CNRST of Rabat (Morocco)

Christel Maillet

INRAE, Micalis Team, France

Morocco is a country of traditions, particularly culinary ones, due to the richness and diversity of its traditional recipes associated with the benefits of the Mediterranean diet. Like many countries worldwide, including in Africa, it has been facing for several years a shift in dietary habits, with populations moving away from traditional cuisine towards fast food and lower-quality diets. The incidence of metabolic diseases such as type 2 diabetes and obesity is increasing, as is the case in France and more broadly in Europe. The country has developed a National Multisectoral Nutrition Strategy (2024–2030) to combat obesity, which could inspire other African countries affected by the same epidemic.

In 2017, a new collaboration between INRAE (France) and CNRST (Morocco) emerged following the secondment of an INRAE researcher to CNRST for two years, with the aim of promoting Morocco's microbial genetic resources, particularly fibrolytic bacteria isolated from Moroccan extreme ecosystems and preserved within the Coordinated Moroccan Collections of Microorganisms (CCMM/CNRST), for applications in human nutrition, health, and biotechnology.

This collaboration has enabled the launch of several research projects and the co-supervision of master's students from various Moroccan universities, followed by a PhD candidate recruited in Morocco who conducted part of their research at INRAE in France. Around forty bacterial strains from the CCMM collection, belonging to the genus *Bacillus*, were selected to study their fibrolytic activities on purified complex polysaccharides or natural fibers present in Moroccan fruits and vegetables, with a particular focus on dietary fibers reaching the colon during digestion. At the end of this first phase, nine strains belonging to *B. licheniformis* and *B. paralicheniformis* were selected for in-depth investigation following the recruitment of the PhD student under a French ministerial fellowship.

A combined approach—including enzymatic assays, secretome analysis, and genomic analysis—was used and demonstrated novel hemicellulolytic activities in *B. paralicheniformis*. With fibrolytic capacities very close to those of commensal bacteria in the gut microbiota, one of these strains was proposed as a candidate probiotic to help rebalance gut microbiota functions in individuals with obesity and to assess potential health benefits.

This collaboration has led to the publication of two articles in international journals, the completion of a PhD thesis defended in 2023 (Université Paris-Saclay), and numerous presentations at national and international conferences. A review dedicated to the CCMM collection is currently in preparation.

In 2026, a new research project was submitted to the TSARA call for proposals to valorize traditional fermented food products from Morocco and study their impact on the composition and functions of the gut microbiota in individuals with obesity. The recruitment of a Moroccan or Senegalese PhD candidate is also envisaged to support collaborative projects between the two institutes.

In parallel with research and valorization activities, several complementary initiatives have been jointly carried out by INRAE and CNRST researchers, notably the organization of two workshops:

• International Course in Biostatistics, "From descriptive and inferential analysis to data mining," held at CNRST headquarters from 4 to 6 April 2018.

• 7th International Course in Metagenomics and Bioinformatics, held from 5 to 7 December 2018 at CNRST headquarters. Combining lectures and practical sessions, this training for around sixty participants reviewed recent advances in (meta)genomic, bioinformatic, and biostatistical analyses. Practical sessions, reserved for about thirty participants familiar with Unix/Linux and Matlab, focused on case studies illustrating current bioinformatics approaches.

In this capacity-building dynamic, two Moroccan researchers also recently benefited from bioinformatics training at the MaIAGE unit of INRAE Jouy-en-Josas.

Finally, as a continuation of this collaboration, the first edition of the Euro-African Congress on the Valorization of Microbial Genetic Resources is currently being prepared in partnership with CRBIP. Scheduled for 18–20 May 2026 in Rabat (Morocco), this event will bring together European and African communities from research, industry, and public policy to exchange on various aspects related to the valorization of microbial genetic resources, from isolation to innovation, including legal and regulatory dimensions. This congress also aims to establish a Euro-African network dedicated to the protection and valorization of microbial genetic resources, which could be mobilized in response to major funding calls such as PRIMA, or to industrial needs addressing key challenges such as the agroecological transition.

Centre National pour la Recherche Scientifique et Technique

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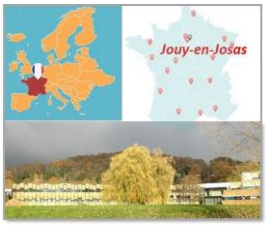
science for people, life & earth

Micalis

Valorization of Morocco's microbial resources for applications in human nutrition and health through sustainable collaboration between the CNRST in Rabat (Morocco) and the MICALIS Institute at INRAE (France)

Bahia RACHED and Christel MAILLET





1st Science days
January 15 2026

MAILLET Christel christel.maillet@inrae.fr
CCMM microbial resources for human health improvment (CNRST/INRAE collaboration)

OUR LABS & EXPERTISES

Biological analysis Services and CCMM



Coordinated Collections of Moroccan Microorganisms (CCMM):

260 species, 1880 strains of bacteria, yeasts, fungi (95% isolated from Morocco)

- Global Catalog of Microorganisms (GCM/ WFCC) and BCCM
- 1st IDA in Africa and Arab countries (2018)



www.ccmm.ma

Central role in microbial resource preservation and implementing the national Access & Benefit Sharing framework





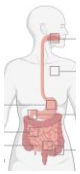


Functionality of the Intestinal Ecosystem (MICALIS FInE)



Human intestinal microbiome:

- Diversity, functions, modulation





Understanding the impact of food on human-microbes symbiosis (mechanisms)





MAILLET Christel christel.maillet@inrae.fr

CONTEXT

Food transitions:

- Fast food and ultra-processed food (vs mediterranean diet)



- Malnutrition (T2D, obesity)
  60% of obese adults in 2050
  -> Strong correlations with dysbiotic intestinal microbiota
  -> Altered fibrolytic and fermentation functions



- National Multisectoral Nutrition Strategy (2024-2030) in Morocco - One Health worlwide





PROJECT

Search for beneficial microbes (new probiotic candidates) for Health



Identify and characterize fibrolyt strains from the CCMM
(plant carbohydrates representative of dietary fibres)



Impact in *ex vivo* models of gut microbiota in obesity
Rebalancing gut microbiota
Restoring intestinal homeostasis



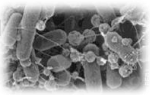
MAILLET Christel christel.maillet@inrae.fr

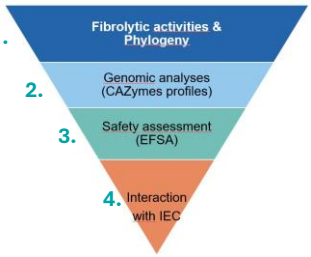




Inssa NGOM
PhD student
(Paris-Saclay univ.)

40 strains of *Bacillus* sp. from the CCMM





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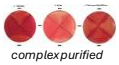
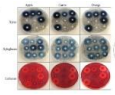
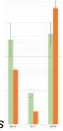


complex purified polysaccharides



natural fibres (orange, carrot, apple) representative of dietary fibres



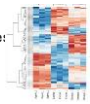
-> 9 strains with hemicellullolytic activities
-> Xylanases & lichenases only in *B. paralicheniformis*
-> Phylogeny of *Bacillus paralicheniformis* (MLST, genomes)



2.

128 CAZymes: 67 GHs from 32 GH families and sub-fam various substrate specificities.

Secretome (LC-MS/MS): natural fibre induce various extracell enzymes





Complete set of GH genes dedicated to the degradation of DFs

3. Intrinsic antibioresistance:
no transferable antimicrobial resistance.
No toxigenic activity.

4. Intestinal barrier integrity
Transepithelial Electrical Resistance (TEE



Qualified Presumption if Safety (QPS)

MAILLET Christel christel.maillet@inrae.fr
CCMM microbial resources for human health improvment (CNRST/INRAE collaboration)

Ngom et al, 2023 Scientific Reports
Maski et al., 2021 3Biotech

CONCLUSION

- Sharing knowledge and methodology to better understand the functions of Moroccan microbial resources
- Provide concrete solutions to boost the fibrolytic functions in various microbial ecosystems
- Enhancing international visibility of our collaborative works

PERSPECTIVES

- "PROFIMA" starter project (submitted to AMI TSARA 2026)
- Recruitment of a Moroccan or Senegalese PhD student to support our collaborative projects

Leveraging CNRST's scientific expertise and territorial anchoring to strengthen TSARA's impact in Morocco.

1st Science days
January 15 2026

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CCMM microbial resources for human health improvment (CNRST/INRAE collaboration)

Get in touch with us

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INRAE science for people, life & earth
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Agricultural Transformation and Food Security in Africa: Challenges, Lessons, and Future Prospects

Bekele Wege Feyisa

Addis Ababa University, Ethiopia

Despite concerted efforts by governments and international multilateral organizations, progress toward ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture in Africa—as outlined in the Sustainable Development Goals and Agenda 2063—remains limited. As part of broader economic development efforts aimed at eliminating hunger, eradicating poverty, and ensuring food security, African governments agreed in 2003 to transform their agricultural sectors through a continental initiative—the Comprehensive Africa Agriculture Development Programme (CAADP) (AU-NEPAD, 2003). Whether this initiative has achieved significant impacts in eradicating food insecurity has received considerable attention from both policymakers and academics. The existing but limited studies on the effects of agricultural transformation on food security in Africa provide valuable insights for policymakers. Nonetheless, the findings of these studies cannot be generalized to all African countries due to the continent's heterogeneity. A systematic review of existing studies from different regions of Africa is therefore important to synthesize the available evidence in a comprehensive and transparent manner.To comprehensively review and synthesize the effects of agricultural transformation on food security in Africa, a systematic review of the literature was conducted using the updated Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. Relevant studies were searched in the Scopus database and Google Scholar, yielding 505 studies. Following predefined inclusion and exclusion criteria, 13 studies that examined the effects of agricultural transformation on food security in Africa were included in this systematic review. The findings reveal that while the efforts made over the last two decades toward transforming agriculture in Africa are commendable, the actual level of agricultural transformation has been limited. The results further indicate that almost all countries are off-track in achieving CAADP's continental targets. Despite the progress made in reducing hunger and food insecurity early in the 21st century, the number of people facing hunger and food insecurity in Africa has been rising over the last 10 years, even before the outbreak of COVID-19. Regarding the potential effects of agricultural transformation on eradicating food insecurity in Africa, the synthesis of the studies included in this systematic review largely shows that efforts to transform agriculture have positively contributed to improving food security. In this context, investing in the most effective components of agricultural activities, strengthening climate resilience and adaptation, and ensuring good governance and political will to implement evidence-based policies are essential for transitioning African agriculture and ensuring food security.

Agricultural Transformation and Food Security in Africa

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Addis Ababa University
E-mail: bekele.wegi@aau.edu.et

January 15, 2026

Context and gaps: Agricultural Transformation and food security

- African governments agreed in 2003 to transform their agricultural sectors through the ***Comprehensive Africa Agriculture Development Programme*** (CAADP) (AU-NEPAD, 2003).

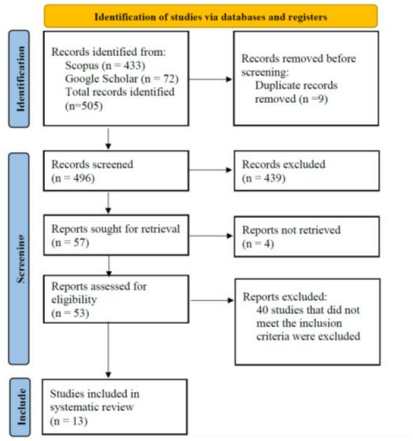
- Whether this continental initiative has achieved significant impacts in eradicating food insecurity has received considerable attention from both policymakers and academics.

- Existing macro level studies have found rather mixed results.
- This systematic review aimed to synthesize the impact of agricultural transformation on food security in Africa

Methodology: Agricultural Transformation and Food Security in Africa

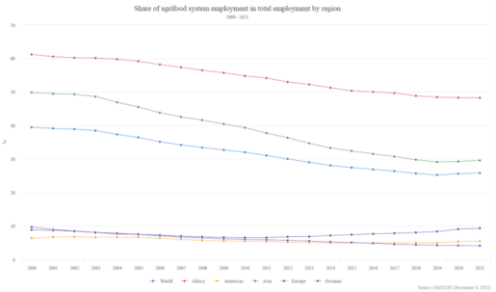
Scopus

Google Scholar



Key findings: Agricultural Transformation and Food Security in Africa

- The overall level of agricultural transformation on the continent has been limited.
- All countries are off track in achieving the CAADP continental targets.
- Studies demonstrate that countries with better investment in agriculture have better food security,
- Climate change, conflicts, and other macroeconomic variables also affected food security



Source: Author's computation from Faostat

Implicato: Agricultural Transformation and Food Security in Africa

- Investing in the most effective components of agricultural activities,
- Strengthening climate resilience and adaptation,
- Ensuring good governance and political will to implement evidence -based policies are essential for transitioning African agriculture and achieving food security.

Parallel session B - Food processing technologies and/or water-energy-food nexuses

Performance drivers in West African cashew processing SMEs: An integrated analysis of technical and organizational factors

Mamadou Tanou Diallo

Université Gaston Berger, Senegal

In West Africa, the processing of cashew nuts represents a strategic opportunity for local value addition, moving beyond the traditional model of exporting raw materials. This study examines four small and medium-sized enterprises (SMEs) in Senegal and Burkina Faso, representative of artisanal and semi-industrial models. An integrated evaluation, combining material and energy flow analysis, organizational diagnostics, and economic assessment, reveals that performance disparities are primarily attributable to operational control and coherent production management, rather than the level of mechanization alone. The results identify several determining factors. The hydration-dehydration phase, encompassing steaming and drying, is critical, as its poor execution negatively impacts the entire process. The shelling and peeling operations are direct determinants of the whole-kernel yield and final economic value. Furthermore, the observed inadequacy of thermal equipment in the SMEs leads to suboptimal energy efficiency, which penalizes productivity. Finally, the human and organizational dimension—operator skill, remuneration models, and strategic staff allocation—proves as significant as technical aspects in adjusting production and improving bottlenecks. In conclusion, the competitiveness of these SMEs hinges on the coherent integration of equipment into a well-organized production process, not merely on machinery. The central finding is that significant performance improvements are accessible without heavy investment, through optimized control of critical processes, work organization, and energy management. These operational levers thus provide a concrete pathway to consolidate the West African processing sector and support its sustainable development.

What really drives SMEs performance in West African cashew nut processing?

Mamadou Tanou Diallo[a,b*], Joseph Bassama[b], Arnaud Chapuis[c] et al.

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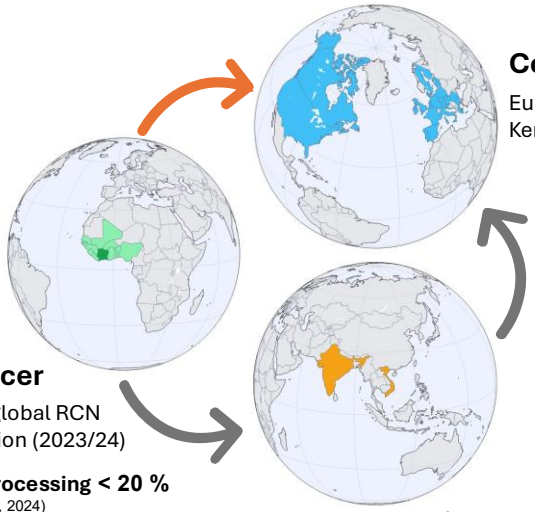
**Corresponding author:* tanou.diallo@outlook.com

West African cashew nut: big producer, small local value capture



Consumers

Europe 33% + USA 17% of Kernels imports (2023)

Producer

55% of global RCN production (2023/24)

Local processing < 20 %
(Bosch et al, 2024)

Processing hubs

92% of global RCN imports (2023)

Today : RCN export → processing abroad

Target : More local processing → export-grade kernels

RCN = Raw Cashew Nuts

INC, *Nuts & Dried Fruits Statistical Yearbook* (2024)

3

Study design: multi-case audit with integrated analysis

<u>4 SMEs (A – D) – Senegal & Burkina Faso</u>

SME A, semi-industrial, *Senegal*

SME B, artisanal, *Senegal*

SME C, semi-industrial, *Burkina Faso*

SME D, semi-industrial, *Burkina Faso*

<u>Data collection</u>

Interviews

Observation

Measurements

<u>Indicators</u>

Yield (whole kernel)

Energy (SEC)

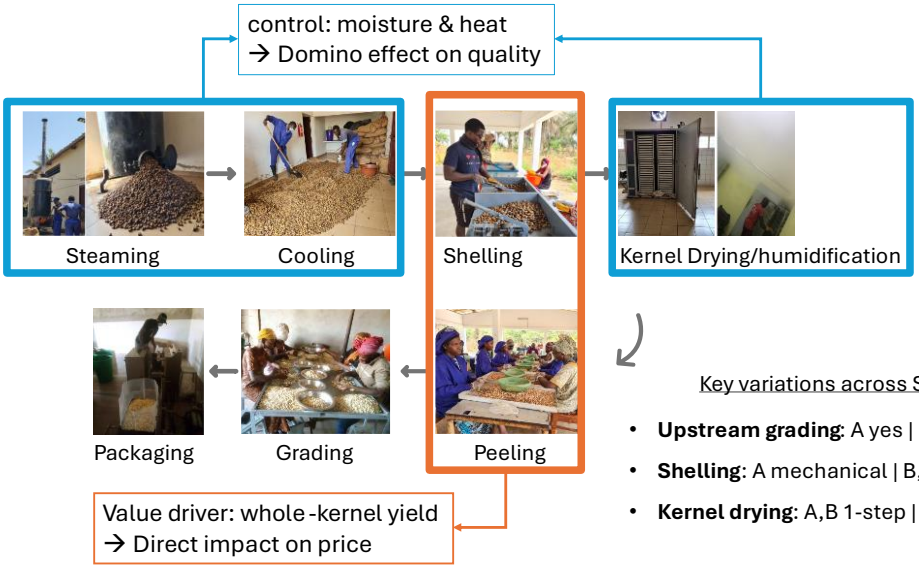
Labor (utilization rate)

Profitability (gross margin)

Normalized: per 1,000 kg kernels

4

Process map + critical operations



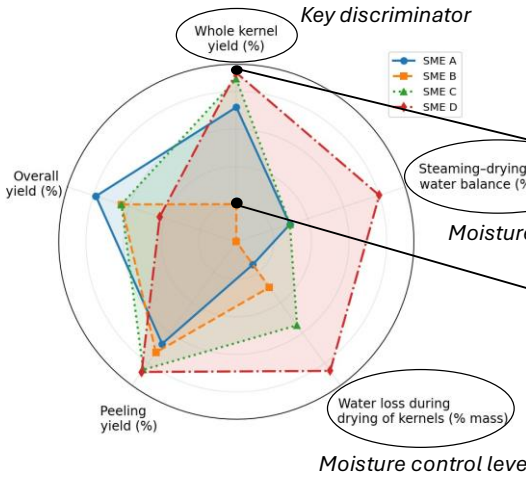
Key variations across SMEs (A-D)

- **Upstream grading**: A yes | B,C,D no
- **Shelling**: A mechanical | B,C,D manual
- **Kernel drying**: A,B 1-step | C,D 2-step + humid

Photos: Senegal (M. T. Diallo) | Burkina Faso (M. Sacla Aïde)

5

Whole-kernel yield is driven by moisture control



Best : SME D
Whole-kernel yield: 84%

Worst : SME B
Whole-kernel yield: 42%

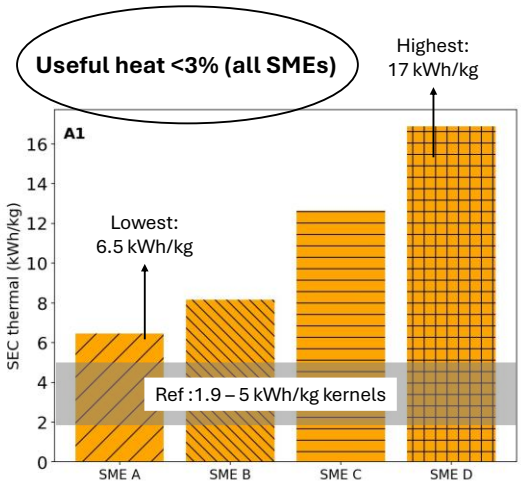
Whole-kernel yield across SMEs: 42-84% **(> 65% target)**

Ref: Azam-Ali & Judge (2001)

Drying loss should not exceed steaming gain

6

Thermal energy dominates – and is mostly lost (useful <3%)



Electricity: 0–420 kWh/t kernels (mainly drying)

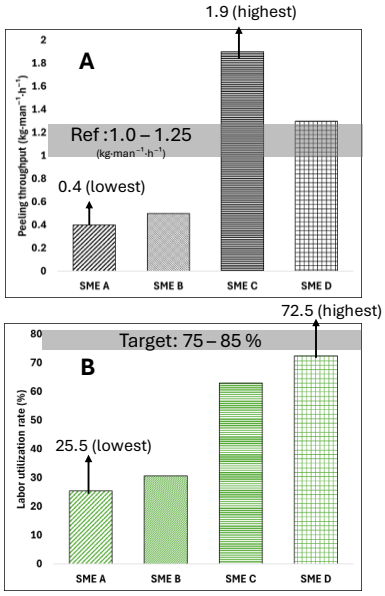
Main thermal users
- **Steaming**
- **Kernel drying (largest share)**

Loss drivers
- **Leaks + no insulation**
- **Incomplete combustion**
- **Dispersed layout (in-line losses)**

Insulate + seal + shorten lines

Ref: thermal energy consumptions (Mohod et al, 2011 & Dhanushkodi et al., 2016)

Bottlenecks + staffing explain productivity gaps



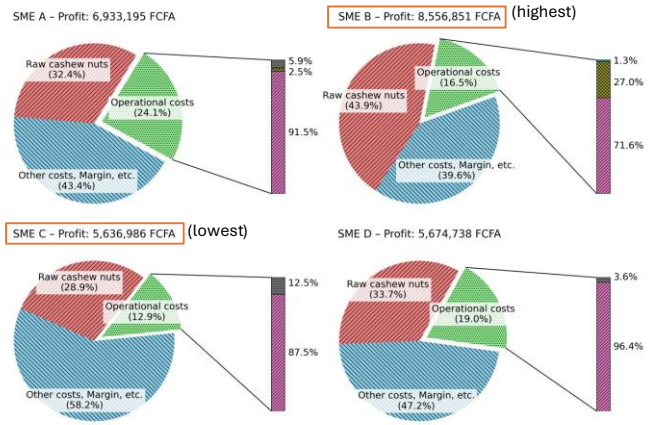
Key bottlenecks
- **Peeling (most constraining)**
- **Shelling (also critical)**

Organizational levers
- **Batch cadence**
- **Task reallocation (reduce idle time)**
- **Skills + incentives (piece-rate vs day-rate)**

manage bottlenecks + increase staff utilization

LUR target: **75–85%** (Abdullah & Rodzi, 2011; Kumbhakar & Zhang, 2013)
Peeling throughput: **1.0–1.25** (kg·man^{-1}·h^{-1}) (Dhanushkodi et al., 2016)

Profitability is driven by pricing + labor deployment



margins exist
Profit per 1,000 kg kernels: ~5.6 – 8.6 M FCFA

Main cost driver (operational costs)
Labor: ~72–96%

Peeling = main bottleneck

Cut labor cost/kg = increase peeling throughput + flexible staffing

9

Performance is about control + organization, not just mechanization

Key findings

- **Moisture control → whole-kernel yield**
- **Thermal efficiency: useful heat <3%**
- **Bottlenecks + staffing → productivity & costs**

Practical low-investment levers

- **Set simple control rules (mass/moisture targets)**
- **Insulate + seal leaks + shorten lines**
- **Raise peeling throughput + flexible staffing**

Significant gains → achievable without heavy investment

Study limits: Based on 4 SMEs (Senegal & Burkina Faso)– analytical, not statistical; results to confirm across more campaigns.

10

Impact of peanut varieties on the nutritional quality

Doriane Delacroix Ouedraogo

AgroParisTech, INRAE, Université Paris Saclay, Cirad, UMR AGAP, France

Peanut is an annual plant with a high nitrogen fixation capacity (approximately 100 kg/ha), contributing to soil fertility. The high protein content of its seeds makes it a strong candidate for producing low-cost, high-protein foods. With the growing consumption of plant-based proteins, particularly legumes, peanuts offer a sustainable and environmentally friendly alternative to animal proteins. They are also an important protein source used in the treatment of severe acute malnutrition (e.g., Plumpy'Nut® produced by the Nutriset group).

However, plant proteins generally have lower quality than animal proteins due to limited levels of indispensable amino acids (IAAs), such as lysine and sulfur-containing amino acids (methionine and cysteine). Protein quality is defined by its ability to provide the nine IAAs that cannot be synthesized by the human body. In addition, digestibility is another key component of protein quality. The FAO/WHO recommends the Protein Digestibility-Corrected Amino Acid Score (PDCAAS) to evaluate protein quality based on amino acid profile and digestibility.

The composition of IAAs varies among varieties. Although around 15,000 peanut varieties are listed in international gene banks, only a small proportion is actually cultivated. Moreover, the genetic basis of amino acid composition in peanut remains poorly understood. Recently, a core collection of 300 varieties was assembled from 1,200 accessions across 10 breeding programs in 9 African countries and evaluated for agronomic and nutritional traits. This core collection represents a valuable genetic resource to explore peanut diversity for nutritional traits and to identify genomic regions controlling these characteristics.

This project aims to mobilize peanut diversity through combined biochemical, nutritional, and genetic approaches to identify varieties with enhanced nutritional quality. Biochemical data on protein and IAA contents will be used in genome-wide association studies to identify molecular markers associated with amino acid and protein composition.

The thesis project promotes the use of crop diversity to breed varieties with high nutritional quality that are also adapted to agroecological systems.



Impact of peanut varieties on the nutritional quality

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This work was supported by INRAE and CIRAD through "Transformer les systèmes alimentaires et l'agriculture par une recherche en partenariat avec l'Afrique (TSARA)" programs, and France 2030 program "ANR-11-IDEX-0003" from the Graduate School Biosphera and C-BASC consortium of the Université Paris-Saclay ».

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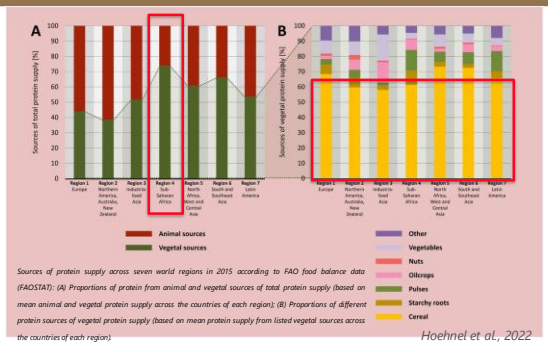
Plant-based proteins consumption

- Animal proteins pose several challenges
- Plant proteins are increasingly consumed
- Plant-based protein consumption is important in Africa
- However Vegetal protein intake is mainly covered by cereal foods worldwide which is lower in protein content

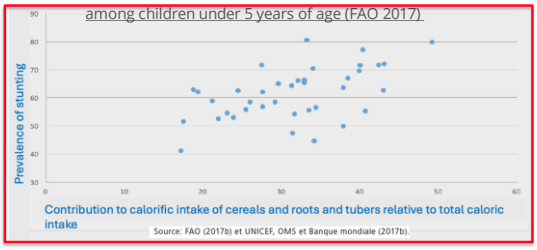
Aiking & de Boer,2020
Hoehnel et al.,2022



Sources of protein supply across seven world regions in 2015 according to FAO food balance data (FAOSTAT): (A) Proportions of protein from animal and vegetal sources of total protein supply (based on mean animal and vegetal protein supply across the countries of each region); (B) Proportions of different protein sources of vegetal protein supply (based on mean protein supply from listed vegetal sources across the countries of each region).

Hoehnel et al., 2022

Caloric intake from cereals and tubers, and the prevalence of stunting among children under 5 years of age (FAO 2017)



- Child growth stunting is common in low-income countries
- Low protein content in cereals compare to pulses
- Proteins are essential for growth, maintenance and physiological functions

Adhikari et al.,2022

A global shift towards predominantly plant-based diets is widely regarded as an effective strategy to improve food system sustainability, but it requires **attention to diversity and nutritional quality**

Protein quality

Protein quality is defined through different indicators :

- **Amino Acids composition**
- **Digestibility**

Absorption and metabolic fate of Indispensable Amino Acids (IAAs)

Adhikari et al.,2022

- Plant proteins have a lower protein quality than animal proteins
- The lower protein quality is associated with a lack of certain IAAs and lower digestibility
- Plant proteins provide less complete protein due to deficiencies in indispensable amino acids, compared with animal proteins

Essential Amino acid profiles of common protein sources. Each EAA (mg/g protein) is ranked by colour according to the amount of EAA in the protein source compared to the other sources (dark green is highest and white lowest). n.d. = not determined. Data sources are provided in Supplement Table 1.

Essential Amino acids	Basic		Neutral	Neutral (branched chain)			Aromatic		Sulphur AA
(mg/g protein)	Histidine	Lysine	Threonine	Isoleucine	Leucine	Valine	Phenylalanine + Tyrosine	Tryptophan	Methionine + Cysteine
Animal proteins									
Cow milk	28	84	47	53	99	65	95	14	30
Sheep milk	29	90	49	54	105	69	99	17	33
Goat milk	30	97	54	69	105	80	111	15	42
Caseins	31	85	46	59	102	76	114	14	33
Whey protein	16	109	88	74	121	69	75	17	52
Beef	31	70	36	40	65	46	61	10	35
Pork	37	76	40	39	71	47	68	11	36
Chicken	34	100	46	52	85	51	40	n.d.	31
Marine Fish	7	76	65	50	96	84	38	20	30
Freshwater Fish	33	33	38	38	57	44	52	6	14
Whole egg	25	78	51	57	91	64	98	12	47
Egg white (albumin)	17	62	36	46	68	49	77	10	38
Egg yolk	33	104	71	65	115	72	114	18	50
House cricket (adult)	24	55	37	47	74	54	83	7	24
Plant proteins									
Wheat flour	26	27	31	37	75	47	85	13	41
Durum wheat	23	24	30	26	70	44	73	13	36
Corn	27	29	36	39	128	51	100	8	44
Cornmeal	27	29	26	38	109	46	88	5	32
Oat	25	43	35	39	76	54	91	9	43
Rice	26	28	37	45	88	63	82	14	44
Rice protein concentrate	17	21	28	34	62	45	104	11	39
Rice protein isolate	17	23	29	34	64	44	86	12	40
Sorghum	18	16	29	34	127	43	76	n.d.	7

Day et al.,2022

Peanut consumption

Peanuts, Arachis hypogaea = nutrition, taste, and affordability

Consumed in different ways : fresh, raosted, boiled, paste…

Protein 20.7%–25.3%, fat 31%–46%

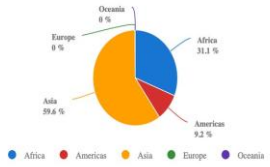
Bonku & Yu,2020

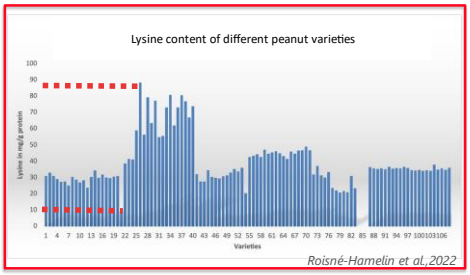
Therapeutic food
Peanuts have been used to combat malnutrition in most developing countries (Plumpy'Nut)

Production share of Groundnuts, excluding shelled by region

Average 2010 - 2023

FAO Stat





Roisné-Hamelin et al.,2022

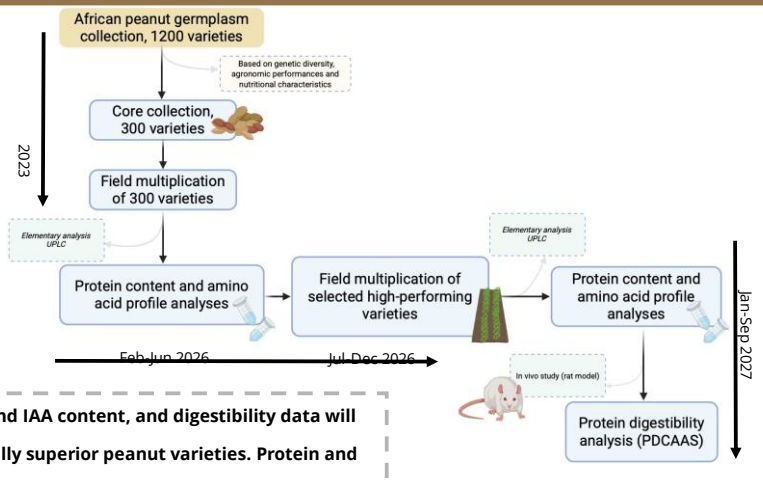
Lysine:

- Limiting IAA in peanut
- **Content varies among varieties**

Peanut is a key oil plant, but genetic base of protein amino acid composition in peanut is poorly understood

Assessing protein quality across peanut varieties

Collection assembled across 10 breeding programs in 9 African countries *Conde et al.,2024*



Agronomic performance, protein and IAA content, and digestibility data will be integrated to identify nutritionally superior peanut varieties. Protein and IAA data will also support genome-wide association studies to develop molecular breeding tools for nutritional traits.





Impact of peanut varieties on the nutritional quality

- Peanut shows strong potential : diversify plant-proteins sources and improve sustainability
- Nutritional quality varies across varieties!
- This project aims to identify varieties combining nutritional and environmental benefits

"If every child, woman, and man in Africa ate a handful of peanuts a day in addition to their normal diet, there would be almost no malnutrition on the continent." FAO

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Diversity of Cameroonian legumes and low-input processing methods for the production of infant flours

Adeline Boire

INRAE, France

Legumes hold an important place in both Europe and Africa due to their nutritional and agronomic value. Rich in proteins, fiber, vitamins, and minerals, they play a key role in food security and soil fertility thanks to their nitrogen-fixing capacity. However, their nutritional potential remains underexploited in Cameroon, particularly for the production of infant flours adapted to the specific needs of young children (6 months to 5 years).

Our collaborative project, through a joint PhD program, aims to address the following question: how can minimal processing of Cameroonian legume seeds be optimized to produce infant flours with high technological and nutritional quality? To achieve this, the project is structured around three main axes: (1) assessing the availability and potential of local legumes for the production of infant flours across the five agroecological zones of Cameroon; (2) characterizing the composition and structure of legume seeds from these contrasting regions, including variability in macronutrients, micronutrients, and antinutritional compounds; (3) studying and optimizing flour production processes and understanding the relationships between intrinsic seed properties and their fragmentation behavior during milling to improve final product quality.

Ultimately, the objective is to develop optimized and adaptable processing methods tailored to the raw material in order to produce infant flours with high nutritional and sanitary quality while promoting local Cameroonian legumes. The expected outcomes could improve food security and infant nutrition in the region, while also supporting sustainable agricultural practices and the use of local resources.

The overall approach of the project is as follows: field surveys will identify farming practices and local processing methods across a diversity of seeds. The collected seeds will then be characterized to assess their composition, structure, and mechanical properties. An initial selection will identify the most promising varieties, which will then be processed into flours and analyzed in terms of microstructure and composition. A second selection will lead to the production of porridges, whose texture and nutritional properties will be studied. This comprehensive approach aims to establish links between the intrinsic properties of seeds, fragmentation mechanisms during processing, and the functional properties of final products, in order to develop an integrated understanding of the continuum from raw material to processing and food use.

Diversity of Cameroonian legumes and sustainable processes for the production of infant flours

Yankam Nkweda, C. [1,2,3], Kansci, G. [1], Saha, B. [1],Kotue Taptue, C. [1], Fogang, A. [4], Riaublanc, A. [2], Réau, A. [3], Barbar, R. [3], Berton-Carabin, C. [2], Boire, A. [2]

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[4] *Université de Douala, Cameroun*

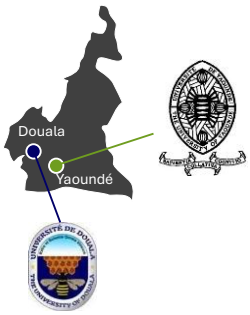
Our consortium

FRANCE



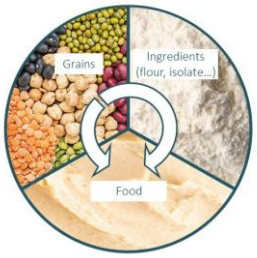
Joint supervision thesis
(2025-2028)
Carole YANKAM NKWEDA

CAMEROON



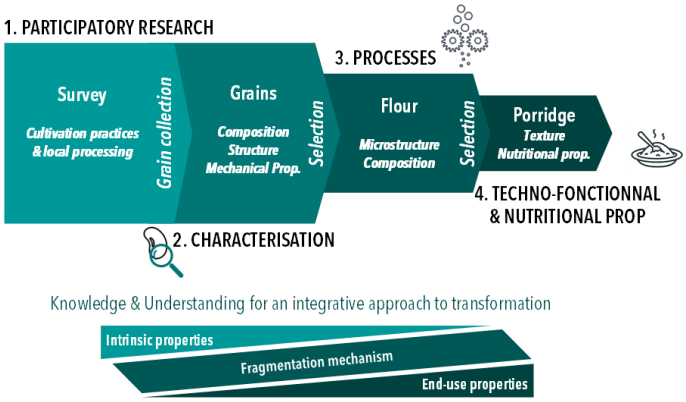
Research question & Objectives

How can we optimize the **minimal processing** of **legume seeds** in Cameroon to produce **infant flours** of high technological and nutritional quality?



Objectives :
(1) assessing the **availability and potential of local legumes** in Cameroon's **five agroecological zones**,
(2) **characterizing the composition and structure** of legume seeds,
(3) studying and optimizing **flour manufacturing processes** for the production of infant flour

Overall approach



Sustainable valorization of edible insects in Cameroon: nutritional quality, process optimization, and stability of flours from *Rhynchophorus phoenicis*, *Imbrasia truncata*, and *Imbrasia epimethea*.

Aymar Rodrigue Fogang Mba

Université de Douala, Cameroun

Edible insects represent a promising pathway for the sustainability of African food systems due to their high nutritional density and local availability. Our work, conducted in collaboration between the University of Yaoundé I, the University of Douala (Cameroon), and INRAE (UR 1268 BIA, Nantes, France), focused on three key species—*Rhynchophorus phoenicis* (Rp), *Imbrasia truncata*, and *Imbrasia epimethea*—to characterize their nutritional value, optimize their processing methods, and improve the stability of their flours and functional protein ingredients.

Analyses showed that these insects have high nutritional quality, with protein contents reaching up to 20 g/100 g fresh weight (FW) for *Imbrasia* spp. and 8 g/100 g FW for Rp. They are also rich in essential amino acids and essential fatty acids (with α-linolenic acid up to 2.17 g/100 g FW), and exhibit low n-6/n-3 ratios (0.15–0.27). Process optimization demonstrated that the combined effect of blanching and defatting produced more stable insect flours, with around 60 g/100 g protein, maintained solubility after 50 days of storage at 40 °C, and limited protein and lipid oxidation.

The protein concentrate obtained from Rp larvae through alkaline extraction had a protein content of 70.7% and displayed a protein composition largely similar to that of meat. This ingredient demonstrated strong functional properties, including a maximum solubility of 84.6% at alkaline pH and the ability to stabilize oil-in-water emulsions with fine droplets (d4,3 < 2 µm), remaining stable against creaming for one week at 4 °C, confirming its potential for food formulation.

Finally, adsorption isotherms made it possible to estimate shelf life at 20 °C (3% moisture content), reaching 263 days for Rp and up to 732 days for *I. epimethea*, highlighting the importance of moisture control for the stability of insect flours.

These results provide a solid knowledge base for the sustainable valorization of African edible insects, the reduction of post-harvest losses, and the integration of these functional protein ingredients into African food systems.

SUSTAINABLE VALORIZATION OF EDIBLE INSECTS IN CAMEROON: NUTRITIONAL QUALITY, PROCESS OPTIMIZATION, AND FLOUR STABILITY OF *Rhynchophorus phoenicis (Rp)*, *Imbrasia truncata (It)*, AND *Imbrasia epimethea (Ie)*



Rhynchophorus phoenicis



Imbrasia truncata



Imbrasia epimethea

Authors:

Aymar Fogang (Université de Douala, Cameroun), **Germain Kansci, Sophie Ngono** (Université de Yaoundé I, Cameroun), **Audrey Geairon, Michèle Viau, Adeline Boire, Claude Genot, Alain Riaublanc** (INRAE, France)

2013 → **20XX**

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KEY NUTRITIONAL VALUE

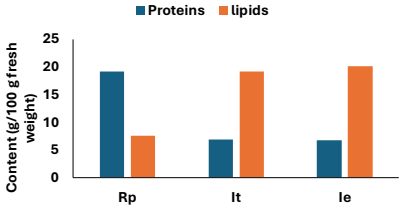


Fig . 1 Lipid and protein content of Rp, It and Ie (g/100 g FW)

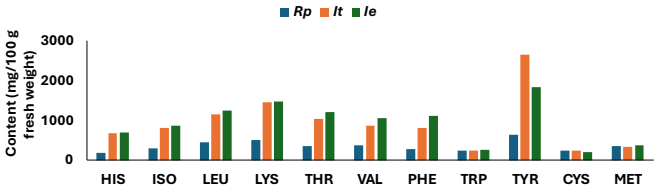


Fig . 3 Amino acid content of *Rp*, *It* and *Ie* (g/100 g FW)

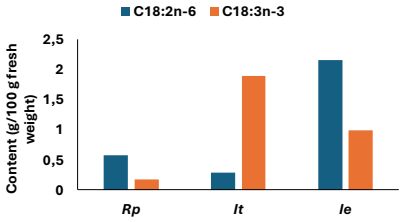


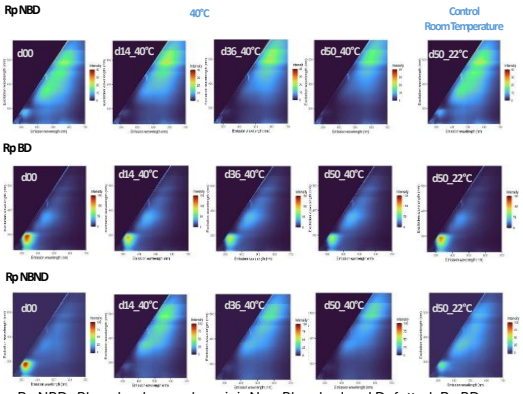
Fig. 2 Essential fatty acid content of Rp, It and Ie (g/100 g FW)

✓High source of protein and lipids c omparable to most meat products (**Fish, Beef, Chicken**)
✓Source of essential fatty acids (**It and Ie, 100 g > 100% RDA**)
✓Source of indispensable amino acids: ***Rp* (3927.7 mg/100 g FW), *It* (10228 mg/100 g FW), *Ie* (10310 mg/100 g FW)**

→ **Potential use in the formulation of complementary foods to combat protein-energy malnutrition**

2/4

PROCESSING METHODS & FLOUR STABILITY



Rp NBD: *Rhynchophorus phoenicis* Non-Blanched and Defatted; Rp BD: *Rhynchophorus phoenicis* Blanched and Defatted; Rp NBND: *Rhynchophorus phoenicis* Non-Blanched and Non-Defatted. Each spectrum presented is the average of three spectra that were normalized by the protein content of the sample.

Fig. 4 3D-EEFM spectra of the flour of *Rhynchophorus phoenicis* larvae under different treatments at day 0, 14, 36 and 50.

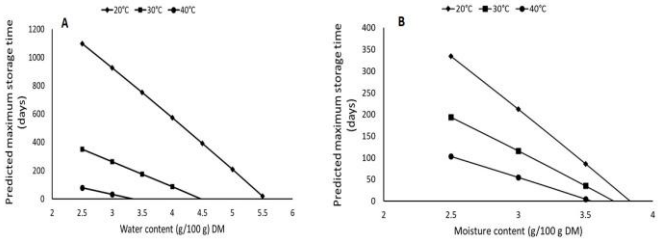


Fig. 5 Predicted maximum storage time (days) at 20, 30 and 40°C as a function of initial moisture content (g/100 g DM (dry matter)) for flours of *Rhynchophorus phoenicis* (A) and *Imbrasia truncata* (B).

- **Predicted shelf-life at 20 °C** (Adsorption isotherm) :**~263 days for *Rp* and ~116 days for *It* at 3.0 g/100 g DM**, highlighting drying as a key strategy to enhance flour stability
- **The blanching + defatting combination significantly improves the stability of insect flours** (limited protein and lipid oxidation is observed).

3/4

FUNCTIONAL PROTEIN INGREDIENTS

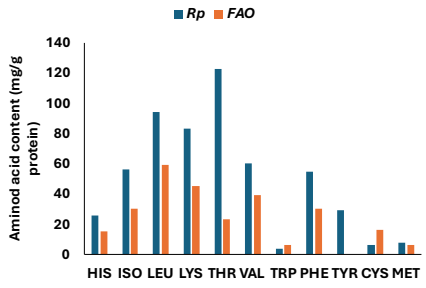


Fig. 6 Indispensable amino acid composition and content of *Rhynchophorus phoenicis* larvae protein concentrate (*Rp PC*)

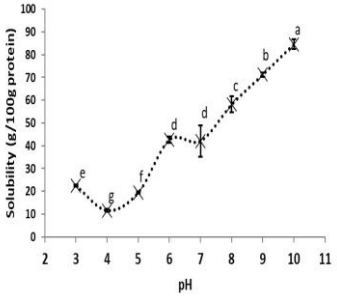


Fig. 7 Effect of pH on the solubility of *Rhynchophorus phoenicis* larvae protein concentrate (Rp PC)

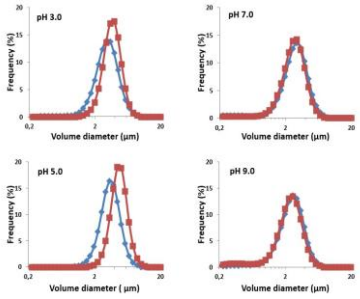


Fig. 8 Distribution of the droplet size of oil-in-water emulsions prepared with *Rp PC* dissolved at different pHs (90:10 water: oil ; 7,1 mg protein/mL). Blue: presence of SDS; red: absence of SDS

- Protein concentrate with a protein content of 70.7%
- Maximum solubility at alkaline pH: 84.6%
- Formulation and stabilization of small emulsions (d4.3 < 2 µm)

Edible insects can be used to enhance the supply of sustainable protein in African food systems

References

4/4

Sociotechnical analysis of the mango sector in Senegal: an overview of the Africold project

Fatou Toutie Ndoye

INRAE, FRISE, France

In Senegal and Tanzania, approximately 40–45% of fruits and vegetables are lost during post-harvest handling due to factors such as inadequate cold chain infrastructure and poor technology management. These significant losses not only have environmental impacts but also undermine food security, while threatening the economic stability and livelihoods of millions of smallholder farmers. In this context, the AFRICOLD project (2025–2026, TSARA funding) aims to assess existing food supply chain systems in Senegal and Tanzania and propose tailored solutions to reduce post-harvest losses. The project brings together three academic partners: INRAE FRISE (France), UCAD (Senegal), and UDSM (Tanzania).

This article presents an overview of the initial work carried out on the mango value chain in Senegal. The methodology combined several complementary approaches: a literature review, stakeholder identification, and an extensive field study. The latter included a socio-technical diagnosis based on qualitative interviews with stakeholders, along with monitoring of supply chain infrastructure (storage, transport, etc.) using real-time sensors to collect quantitative data such as temperature, humidity, and time.

The socio-technical diagnosis was structured into three phases: (i) development of the theoretical framework, stakeholder mapping, and identification of production zones; (ii) empirical fieldwork conducted in Senegal; and (iii) analysis of interview transcripts. A total of nine semi-structured interviews were conducted across a range of companies to gather qualitative insights. Participants were selected to ensure representation across stakeholder categories and hierarchical levels. Interviews lasted between 30 minutes and 2 hours and covered eight thematic areas: stakeholder identity, interactions, sector evolution, challenges and solutions, practices, regulation, sustainability, and the cold chain.

In parallel, quantitative measurements (temperature, humidity, and time) were carried out along six mango supply chains involving the identified stakeholders. Instrumented mango shipments and associated supply chain stages were monitored using real-time sensors. The collected data were analyzed to characterize temperature and humidity dynamics throughout the chains and to identify potential breaks in the cold chain.

The socio-technical diagnosis proved highly valuable in understanding the overall organization of Senegal's mango value chain and the interactions among actors. One of the key findings is the clear structural difference between supply chains: the absence of a cold chain for the local market, contrasted with a relatively well-controlled cold chain for export-oriented production. In addition, several issues related to insufficient cold chain infrastructure were identified. The quantitative data collected will be used to model mango quality, shelf life, and nutritional attributes using kinetic approaches adapted to the different supply chains studied.

Sociotechnical analysis of the mango sector in Senegal: An overview of theAfricold project.

Fatou Toutie NDOYE, Yasmine SALEHY, Anthony DELAHAYE– INRAE, FRISE, Antony
Mady CISSE, Mountain DIOP, Omar CISSE, Médoune SARR– UCAD, ESP, Dakar
Victor VICENT, Salma DAMLA– UDSM, Dar es Salam

Context & Objective

World Food Losses Due to Lack of Cold in 2017

Global food losses due to lack of refrigeration 12% → 15% CO_2 emissions from global food waste

Source: Sarr et al., 2021; Poore and Nemecek, 2018

Food losses in Sub-Saharan Africa

Food losses due to lack of refrigeration



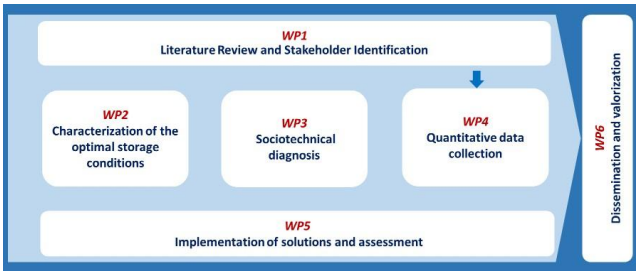
45% Fruits & Vegetables in Senegal
40% Fruits & Vegetables in Tanzania

Main issue:
Absence/fragmentation of cold chain systems

Source : FAO, 2019; World Bank, 2020

Objective

Conducting a comprehensive assessment of the current cold chains in Senegal and Tanzania and proposing context - appropriate solutions to reduce food losses



Partnership

Fatou Toutie NDOYE
Anthony Delahaye
Yasmine Salehy

- Refrigeration processes
- Cold chain diagnosis and solutions
- Cold chain modelling and optimization
- Environmental evaluation
- Industrial engineering



Cold chain

France

Mady Cissé
Nicolas Ayessou
Abdoulaye Tamba
Médoune Gaye Sarr
Papa Guedel Faye
Vincent Mendy
Alkassoum Hanne

- Agri-food sectors & Food systems
- Food safety and quality control
- Optimisation of agri-food processes
- Renewable energy production system



Mango



Carrot

Senegal

Victor Vicent
Salma Damla

- Food science
- Food process engineering
- Stakeholders mapping
- Development of low tech technologies



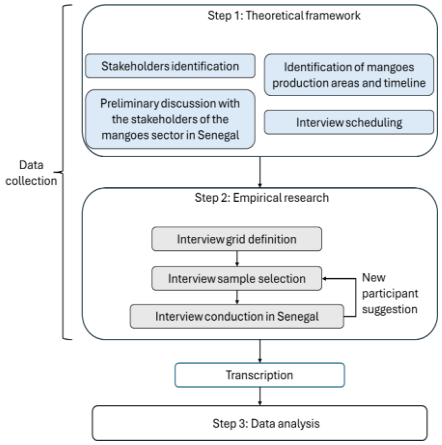
Avocado

Tanzania

Studying the mango supply chain in Senegal

Socio-technical diagnosis

Research methodology



8 topics (55 semi-guided questions) :

- Identity
- Interactions between stakeholders
- Evolution in the sector
- Difficulties and solutions
- Practices
- Regulation
- Sustainability poisitionning
- Cold chain





Studying the mango supply chain in Senegal

Socio-technical diagnosis

Interview conduction



7 interviews (30 – 120 minutes)

NIAYES

Stakeholder 1: Senegalese company 1; Quality manager, Sangalkam, Niayes
Stakeholder 2: Senegalese company 1; General manager, Sangalkam, Niayes
Stakeholder 3: Senegalese company 2; General manager, Sangalkam, Niayes
Stakeholder 4: Senegalese interprofession; Vice-president, Niayes
Stakeholder 5: Senegalese interprofession; Farm workers, Niayes

CENTRE

Stakeholder 6: Senegalese company 3; General manager, Center

CASAMANCE

Stakeholder 7: Senegalese cooperative; General manager, Casamance



Studying the mango supply chain in Senegal

Socio-technical diagnosis

Preliminary results



Value chain of the mangoes in Senegal

CASAMANCE

Stakeholder 7
Senegalese cooperative
(General manager)

(at the mangoes ochard) Pre-harvest	*(at the mangoes ochard)* Harvest	*(at the sorting and packaging station)* Post-harvest
February–May: 1. Forecasts: Discussions with exporters, volumes 2. Tours: Estimates of flowering/ losses/ orchards/ maturity tests by area 3. Pre-campaign organisation: Training of cutters, teams, planning, DPV prepares for opening 4. Campaign officially launched by the DPV	Mid-May to June, typical day of cutting and harvesting: 5. Cutting mangoes for export (the mangoes never touch the ground; they are placed in 18 kg crates (2 rows) usually in the morning 6. Truck collection (usually at 2 p.m.) : covered trucks depart for the station	7. Reception station: unloading, initial sorting and verification of traceability by orchard 8. Washing & secondary sorting: washing, blowing, brushing and secondary sorting by automatic grading machine 9. Packaging: weighing, palletising (sizes 6, 7, mixed), temperature control (by tapping) 9bis. Pre-cooling if too warm 10. Cold room: stabilisation at 10°C (customer) in cold storage room (holds up to 1.5 containers) 11. Export: loading at loading bay, sealing of container or truck (transfer of responsibility to exporter) 12. Transport by road or sea 13. Customer reception

Studying the mango supply chain in Senegal

Socio-technical diagnosis



Preliminary results

Problems encountered

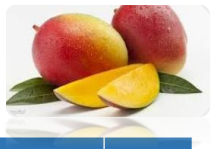
CASAMANCE

Stakeholder 7
Senegalese cooperative
(General manager)

Problem category	Problem description	Citation
Logistics & no truck	Dependance on transporters, high financial losses, transport bottlenecks	"Pas de camion à eux, donc loc et chaque année à perte… si la coop a un camion, ça leur permet de ne pas louer." "Camion marocain… embourbé… 3 jours bloqués donc mangues détériorées et contenu rejeté."
Labor	Cutters difficult to manage/ Shortage of young workers for heavy tasks	"Coupeurs : gosses qui font chanter… coupeur coûte entre 4000 et 4500 CFA/j." "Jeunes qui veulent pas travailler ; difficulté à renouveler le personnel… pour porter les caisses."
	Tiredness / long walking distances for women workers	"Femmes… habitent à 2-3 km… parfois travaillent la nuit… obligées de faire 7-8 km pour rentrer."
Waste	High post-harvest losses : 20–30% waste, market saturation → major economic loss.	"Cette année, le pourcentage d'écarts est entre 20 et 27%." "On a eu à en jeter beaucoup car on n'a pas eu de preneurs." "Une partie perdue car marché saturé à Dakar."
Cold chain and equipment	Old equipments slows production, undermines competitiveness .	"C'est du vieux matériel… il faut moderniser."
	No cooperative control over cold chain beyond loading Lack of cold storage for waste	"Vous ne gérez pas toute la partie froid ? — Exactement." "Si… nous avions 1 autre pour les écarts de tri, ce serait génial…"

Studying the mango supply chain in Senegal

Quantitative data collection



6 equipments

Zone	Stakeholder	Equipment	Circuit	Destination	Number of sensors
NIAYES	Stakeholder 1 (Company 1)	Cold room	International	Sangalkam →Dakar → Anvers →Netherland	2
		Refrigerated truck → Refrigerated shipping containers by boat	International	Sangalkam →Dakar → Anvers →Netherland	11
	Stakeholder 3 (Company 2)	Non refrigerated close truck	Local	Balldiop → Sangalkam	3
		Refrigerated truck → Refrigerated shipping containers by boat	International	Sangalkam → Dakar → Anvers →France	13
CASAMANCE	Stakeholder 8 (Bana Bana 1)	Non refrigerated open truck	Local	Casamance → Thies	3
	Stakeholder 9 (Bana Bana 2)	Refrigerated truck	International (Continental)	Casamance → Ivory Coast	7



Studying the mango supply chain in Senegal

Quantitative data collection

Truck instrumentation

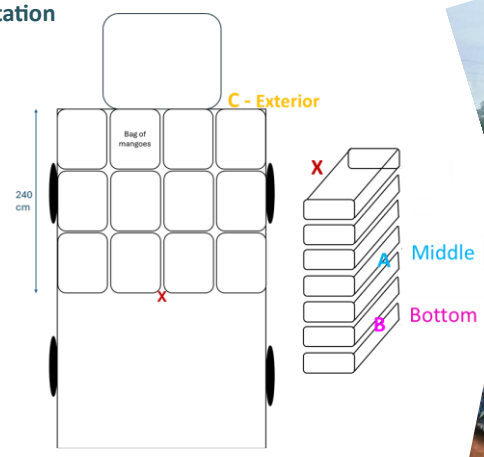


CASAMANCE

Stakeholder 8
Bana Bana 1

Non refrigerated
open truck

Local market
Casamance →Thies



Placement of sensors in the truck

Studying the mango supply chain in Senegal

Quantitative data collection

Preliminary results

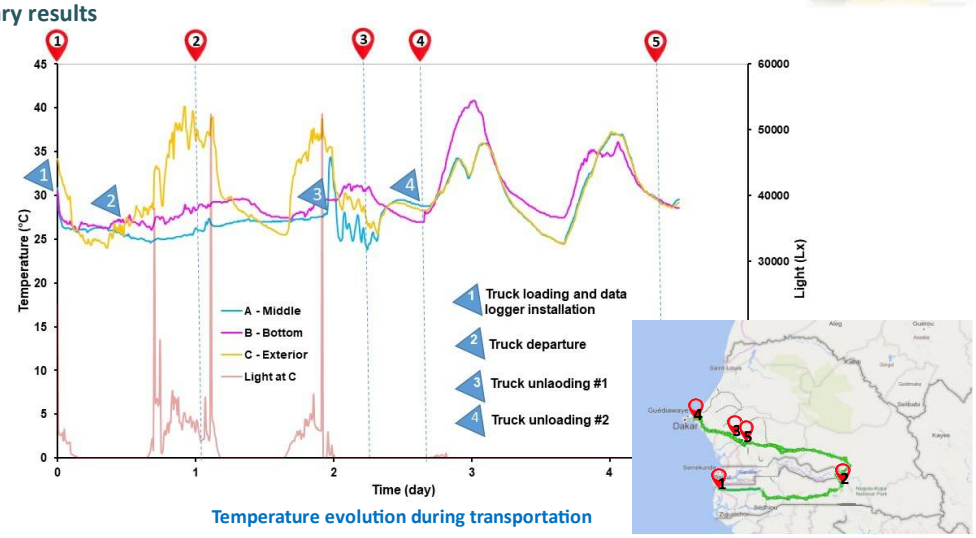


CASAMANCE

Stakeholder 8
Bana Bana 1

Non refrigerated
open truck

Local market
Casamance →Thies



Temperature evolution during transportation

Studying the mango supply chain in Senegal

Quantitative data collection

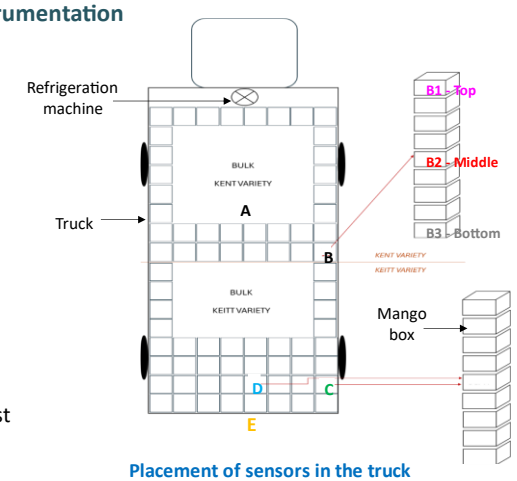
Truck instrumentation

CASAMANCE

Stakeholder 9
Bana Bana 2

Refrigerated
truck

International market
Casamance →Ivory Coast



Placement of sensors in the truck



Studying the mango supply chain in Senegal

Quantitative data collection

Preliminary results

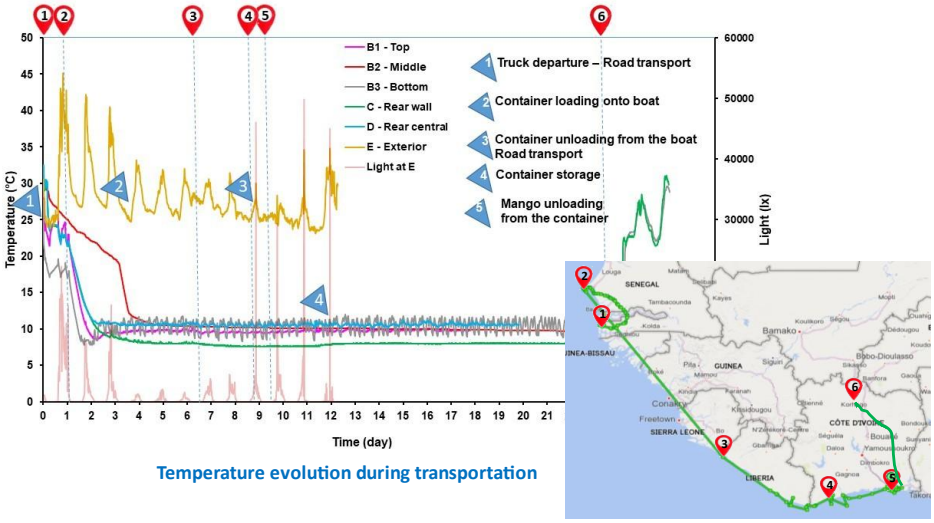


CASAMANCE

Stakeholder 9
Bana Bana 2

Refrigerated
truck

International market
Casamance → Ivory Coast



Temperature evolution during transportation

Studying the mango supply chain in Senegal

Quantitative data collection

Key insights





Future works



WP1: **Expand our literature review and stakeholder mapping** to include the **carrot** sector in Senegal (current focus on mangoes in Senegal and avocados in Tanzania)



WP2: **Test optimal storage conditions** on freshly harvested products – Develop **quality kinetic models**



WP3: **Complete dataset analysis analysis** of the mango value chain in Senegal and **extend the socio-technical diagnosis** to carrot in Senegal and avocados in Tanzania



WP4: **Complete analysis of the mango cold chain** dataset in Senegal and **extend** temperature, RH… monitoring to **carrots and avocados** – Application of **quality models**



WP5: Select **potential technological solutions** and **field test – Assessment** of cooling efficiency, energy use and product quality



WP6: Disseminate outcomes trhough **workshops, seminars, communication materials and scientific publications**



Deliver scalable, context-appropriate solutions to optimize cold chains and reduce postharvest losses

Dynamics and Constraints of Camel Production in Morocco

Fadwa Guimimi

IAV Hassan II, Morocco

For centuries, pastoralism has been one of the main pillars of livelihood systems in Morocco's arid and semi-arid regions. This traditional production system is now facing increasing environmental pressures and profound transformations driven by climate variability and socio-economic change across rural areas. The dromedary remains a vital resource owing to its unique adaptive capacity to harsh environments. It occupies a distinctive position among livestock species: its market value tends to be more resilient during times of crisis, and it remains the most valuable animal within both pastoral and agro-pastoral systems. More than 90% of the national camel population is concentrated in the southern regions of the country. This review paper examines the current status and dynamics of Morocco's camel population, highlighting the main socio-economic drivers, constraints, and opportunities within the sector. Available data indicate fluctuating herd trends, with a declining tendency in recent years. Although the marketing and processing of camel products remain limited, the sector is showing early signs of expansion and demonstrates considerable development potential. The camel sector continues to receive limited institutional and scientific attention and still faces major structural constraints, particularly recurrent drought, rangeland degradation, and restricted market access.



Outline

- Introduction
- Camel Population and Dynamics
- Socio-economic importance of the dromedary
- Valorisation and market development
- Constraints and development opportunities
- Conclusion

Introduction

Pastoralism & Climate Pressure
Strategic Role of the Dromedary in Morocco

- 93% of Morocco classified as arid to semi-arid [1]
- Increasing rainfall variability and recurrent droughts [2]
- Structural water stress < 730 m³/capita/year [3]
- Pastoralism as the most resilient livelihood system [4]
- Dromedary highly adapted to harsh environments [5]

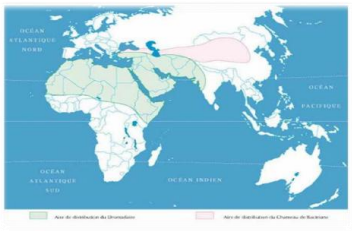


Figure 1: Global distribution of dromedaries across hot and cold desert regions

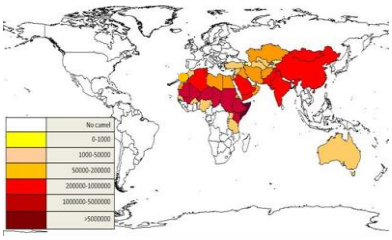


Figure 2: Global distribution of the world camel population

[1] Dahan et al., 2012
[2] Driouech et al., 2016; Berkat et al., 2020
[3] World Bank, 2020
[4] FAO, 2022
[5] Bengoumi & Faye, 2015

Camel Population and Dynamics in Morocco

- ≈ 106,044 dromedaries in 2025 [1]
- > 80–90% located in southern regions [2]
- Declining trend since 2012 due to drought and rangeland degradation [3]
- Negative growth rate: –1.22% (1961–2023) [3]
- Discrepancies between FAO and national statistics [4]

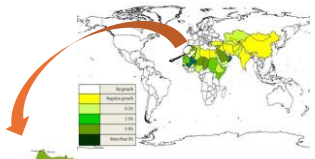
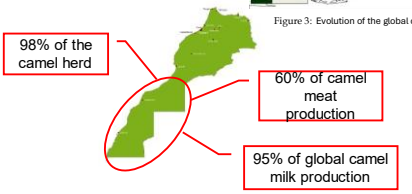


Figure 3: Evolution of the global camel population



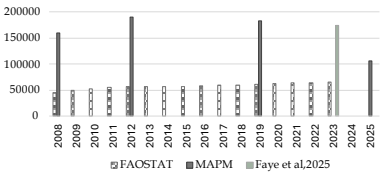


Figure 4: Camel population trends in Morocco (Data compiled by the author: MAPM, 2025 ; Faye et al., 2025 ; FAOSTAT, 2023 (incomplete data) ; MAPM, 2012).

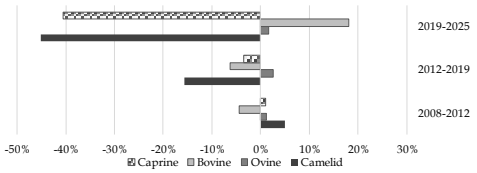


Figure 5: Evolution of camel and general livestock populations in Morocco: Percentage variation from 2008 to 2025

[1] MAPM, 2025 [2] Amsidder et al., 2021; MAPM, 2020
[3] Faye, 2025 [4] Faye et al., 2025

Camel Population and Dynamics in Morocco

Production systems
- Transition from nomadism to hybrid mobility [1]
- Mobile, peri-urban and multi-active herders [2]

Main constraints
- Recurrent drought and rangeland degradation [3]
- High feed costs and market dependency [4]

Emerging opportunities
- High genetic diversity [5]
- Growing interest in camel milk valorisation [6]
- Strategic role in climate-resilient livestock systems [7]



Figure 6: Photographs illustrating the morphological diversity of dromedary camels (Camelus dromedarius) from the Dakhla–Oued Eddahab region, Morocco (photos by the authors).

[1] Amsidder et al., 2021
[2] Kamili et al., 2020
[3] Belmahi et al., 2023
[4] Dahmani et al., 2025
[5] Piro et al., 2020; Boujenane et al., 2019
[6] Faye & Bonnet, 2012
[7] Faye et al., 2022

Socio-economic importance of the dromedary in Morocco

- Central role in pastoral and agropastoral systems [1]
- Valorisation of arid and desert areas [1]
- High resilience to water and feed scarcity [2]
- Strategic pillar of food and livelihood security [2]



The dromedary as a security capital

- Stable or increasing prices during drought periods [3]
- Acts as a store of value for pastoral households [3]
- Source of income and investment reserve [4]



Figure 7: Dried dromedary meat (Tichtar) produced by a cooperative in Dakhla (ADA, 2025)



Figure 8: Traditional dromedary hump fat (Loudek) produced by a cooperative in Dakhla. (ADA, 2025)

Multifunctionality of camel production systems

- Specialized, mixed and oasis-based systems [2]
- Wide range of products and services [2]
- High cultural and symbolic embeddedness [3]

[1] Julien et al., 2021
[2] Kamili et al., 2020
[3] Amsidder et al., 2024
[4] Alary et al., 2021

Valorisation and market development

- Added value doubled between 2008 and 2019 [1]
- Growth of milk processing and cooperatives [1]
- PGI 'Lait de chamelle du Sahara' since 2016 [2]



Figure 9: Diversity of camel milk –derived products produced in Morocco.

[1] MAPM, 2020
[2] Amsidder et al., 2024

Constraints and development opportunities

- Limited research and institutional support [1]
- Health, hygiene and market access constraints [2]
- Growing demand for camel milk and meat [3]
- Strong potential for sustainable development [4]



[1] Faye et al., 2014; Kamili et al., 2020
[2] Boneibacchy et al., 2025
[3] Sghir et al., 2023; Suliman, 2023
[4] MAPM, 2020

Conclusion

- The dromedary is a strategic asset for arid and semi -arid regions
- Strong socio-economic, cultural and territorial value
- Growing potential for milk and meat valorisation
- Major challenges: structuring, health, markets and governance
- A key lever for sustainable and climate -resilient development

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[3]*African Sustainable Agriculture Research Institute (ASARI), Mohammed VI Polytechnic University (UM6P), Laayoune 70000, Morocco*



[1] Faye et al., 2014; Kamili et al., 2020
[2] Boneibacchy et al., 2025
[3] Sghir et al., 2023; Suliman, 2023
[4] MAPM, 2020

Mapping and qualitative characterization of artisanal fermented fishery products in Senegal with a view to process optimization

Marie-France Pilet

INRAE, Oniris, UMR SECALIM, France

In Senegal, many fishery and aquaculture products are processed using traditional methods that combine salting, fermentation, and drying. However, the diversity of local and artisanal practices makes it difficult to control product quality and safety, thereby limiting their potential for development and valorization on national and international markets.

A first study involving the mapping and inventory of fermented products such as “guedj” and yeet, as well as associated processing practices, was conducted in 2025. This study took place in northern and southern Senegal, in the regions of Saint-Louis and Ziguinchor, and included the sampling of selected fish- and mollusk-based products. These samples were analyzed for microbiological characteristics (using both conventional methods and NGS approaches), physicochemical properties (moisture content, pH, NaCl content, and biogenic amine levels), and sensory attributes.

The project, carried out במסגרת the TSARA initiative, brings together partners from Gaston Berger University (Senegal) and the Secalim and Qualisud research units (France), which offer complementary expertise in food microbiology and process engineering applied to seafood products.

In a second phase, the project aims to screen the bacteria involved in the fermentation of fish and mollusks (commonly referred to as guedj and yet) in order to identify strains with functional properties of interest. These selected strains could then be used to improve product quality and safety, with the ultimate goal of optimizing fermentation processes.

SenBICPHa - Cartographie et caractérisation qualitative des produits halieutiques conservés par fermentation artisanale au Sénégal dans une perspective d’optimisation des procédés

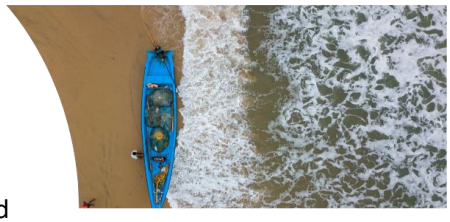
SenBICPHa - Mapping and qualitative characterization of fish products preserved by artisanal fermentation in Senegal with a view to process optimization

Fatou Gueye[1], Michel Bakar Diop[1], Boris Misery[2], Lenaïg Brulé[2], Raouf Tareb[2], Joseph Bassama[1], Corinne Teyssier[3], Ingrid Collombel[3], Elodie Arnaud[3] et Marie France Pilet[2]

1- Université Gaston Berger, Saint Louis, Sénégal, UFR Sciences agronomiques de l’aquaculture et des technologies alimentaires
2- Oniris, INRAE, UMR SECALIM, Nantes, France
3- Qualisud, Univ Montpellier, CIRAD, Avignon Université, Institut Agro, IRD, Univ de La Réunion, Montpellier, France

Contexte and objectives

- Valorisation of halieutic products in Senegal
- Diversity of practices → various final products
- Difficulties to ensure safety and quality and to increase economic value



Traditional aquatic fermented products

Guedj : various fish species, salted, fermented, and dried

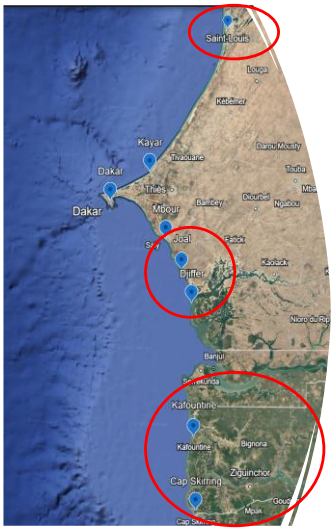
Yeet : mollusk flesh (*Cymbium*) salted fermented and dried

1) Cartography of practices and products characterisation

2) Selection of starter microorganisms to improve safety and organoleptic quality

3) Application at a lab scale

Cartography of practices



Selection of production sites, 3 costal regions in the FAO 34.3.1 area :

Saint-Louis : Guet-Ndar and Goxu Mbathie
Ziguinchor : Boudody, Kafountine and Diogué, Cap-Skiring and Elinkine
Thies : Joal and Djiffer (in progress)

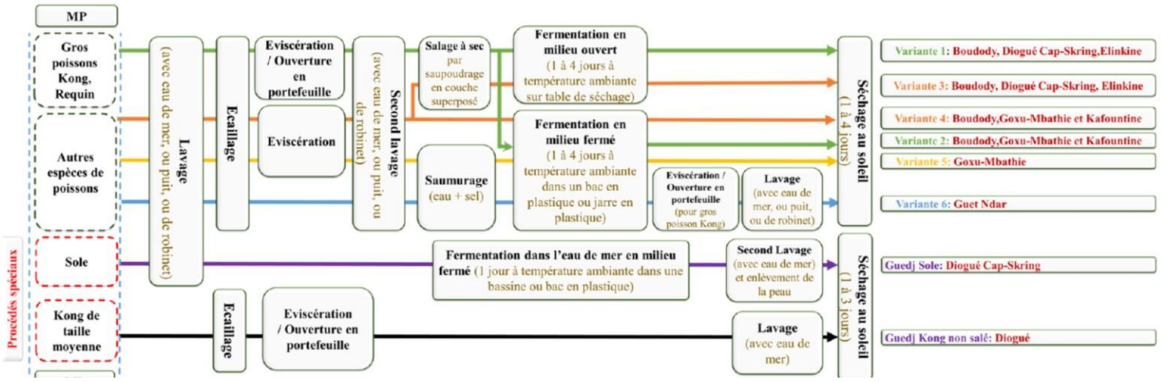
For each site :

- Contact with **representants of Ministry of fishing** and **GIE of women** working in guedj and yeet production
- **Survey** on production volumes, transformation practices : species used, process, hygienic practices…
- **Sampling** of final products **and analysis for qualitative characterization**



Survey analysis : Diversity of processes

Example for guedj : representation of the process variation according primary material and production sites



Survey will give additional data on **products amounts**, **local actors participation**, **hygienic practices…**

Products characterisation

12 guedj (3 fish species) and 8 yeet batches from 6 areas, sampled in triplicates

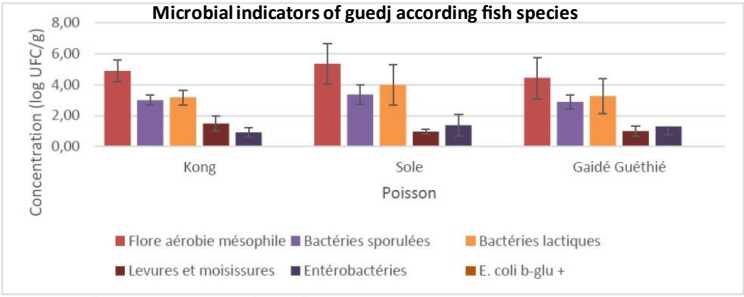
	Guedj		Yeet	
	Mean	Min-Max	Mean	Min-Max
NaCl %	21,7	14,5 - 29,7	27,5	21,4 - 36,1
pH	6,8	6,0 – 7,9	7	6,1 - 8,3
Titratable acidity %	0,67	0,1 - 1,5	0,5	0,0 - 1,5
Humidity %	45,3	32,6 - 53,1	50,5	37,7- 56,9

Neutral pH, high level of salt and humidity

Guedj samples microbiology :

TVC : 4,5 Log UFC/g
Sporulated bact : 3,1 Log UFC/g
LABs: 3,5 Log UFC/g

Community composition will be investigated by **targeted metagenomic**



Conclusion

- **Practice diversity**, implication of **local actors and interest to improve** process and quality
- High level of **sporulating bacteria** (→**safety),** and **lactic acid bacteria** (→**starter cultures)**
- **Cooperation and complementarity between french and senegal partners**
- **Involvement of** master, engineer and veterinary **trainees** from UGB and Oniris (4 students)

Perspectives

→ *Short term within SenBICPha project :*

- Ending of practices survey (Thies region)
- Product characterization : histamine content and microbial communities analysis are in progress
- Selection of starter candidates for test on products at lab scale

→ *Mid term perspective :*

Development of production units **with local women GIE groups** with process and hygiene rules to **improve economic valorization** of guedj and yeet products for restaurants, food industry

Assessment of the Phytotoxicity of Dairy Wastewater Using the Lettuce Plant (Lactuca sativa L.) and Duckweed Plant (*Lemna minor*) as Bioindicators

Oulaya Zoui

ENAM, Morocco

Dairy industry effluents may contain trace metal contaminants, the nature and concentration of which depend on the treatment processes applied during wastewater purification. The presence of these metals in liquid discharges raises significant environmental concerns due to their potential toxicity to both aquatic and terrestrial ecosystems. Furthermore, their bioaccumulation in the food chain poses a risk to human health, highlighting the need for stringent monitoring and effective remediation strategies. To assess the potential phytotoxicity of dairy wastewater, two complementary studies were conducted using the same treated effluents. The first study examined the effects of different wastewater concentrations (25%, 50%, 75%, and 100%) on the germination and early growth of three lettuce (Lactuca sativa) seed varieties (Batavia, Têtue de Nîmes, and Madrilène) under varying seed densities. Key parameters measured included germination rate, seedling length, and biomass. The results indicated no significant differences in germination rate or stem length across treatments, suggesting a limited impact of the tested wastewater concentrations on early lettuce development. The second study evaluated the potential toxicity of the same wastewater on duckweed (Lemna minor) following the ISO 20079 international standard for growth inhibition tests. The experiment was conducted over one week with five replicates per treatment. No significant differences were observed in frond number between treatments, indicating an absence of acute phytotoxic effects on Lemna minor. However, a significant pH variation was recorded between the beginning and the end of the study, suggesting potential physicochemical changes in the test medium that may influence long-term biological responses.

International trade and water management in agriculture: the case of Tunisia

Sarra Kekli

INRAE, UMR Smart, France

Faced with increasing pressure on water resources in Tunisia—pressure that is expected to intensify under the effects of climate change and may compromise national food security—it is essential to analyze the interactions between public policies and sustainable water management. The Tunisian agricultural sector, which accounts for nearly 10% of GDP, relies heavily on irrigation: although it covers only about 8% of cultivated land, it consumes nearly 80% of water resources. A significant share of this water (43%) is used for export crops such as dates and olive oil, whose economic value does not always reflect the volumes of water mobilized.

This PhD research addresses this issue by examining the potential of trade measures as instruments for managing irrigation water demand. The objective is to model the Tunisian economy using a general equilibrium framework in order to test different scenarios in which water is incorporated as a constrained production factor. This approach makes it possible to assess how trade instruments—such as tariffs, taxes, or regional agreements—influence cropping choices, water use, and agricultural specialization patterns.

The first component of the work consisted in building a database linking agricultural production, trade flows, and blue water footprint, by product and by region. This database enabled the identification of spatial irrigation dynamics, the assessment of the blue water footprint of major crops, and the calculation of water valorization depending on market destinations (domestic versus export).

The second part of the thesis focuses on the coherence of public policies—particularly trade and water policies—through the lens of rebound effects. The idea is that efficiency gains associated with water-saving technologies may be offset, or even reversed, by unintended consequences such as the expansion of irrigated areas or the intensification of cropping systems. This phenomenon, documented in countries such as China and Australia, remains largely underexplored in the North African context.

Additional avenues are also considered, including the potential role of instruments such as labels or geographical indications that promote sustainable agricultural practices in water management.

This research contributes to broader debates on the sustainability of agricultural trade, the adaptation of public policies to environmental constraints, and the tensions between export competitiveness and food security. Its objective is not to provide prescriptive recommendations, but rather to deliver a rigorous economic assessment of the effects of different trade policy options on water management in a Mediterranean context.

International trade and water management in agriculture: the case of Tunisia

Project: PhD thesis under the supervision of C. LarocheDupraz (UMR SMART) and A. Cheptea (UMR SMART)

Context

- High water insecurity (Aqueduct 4.0, 2023)
- Water stress is expected to increase with climate change that directly threaten national food security (ONAGRI, 2021)
- Agricultural sector heavily relying on irrigation (80% of water withdrawal). Production directed towards:

→ Domestic consumption: fruits & vegetables, some wheat, meat production/animal fodder

→ Exports: exported crops (olive oil and dates in the top) account for 33% of total production and 43% of the blue water footprint (Kekli et al., 2025)

- Overall, export revenues are not proportional to the amount of irrigation water used
- Food security policy calls for re-evaluation of agricultural exports based on their water footprint (ITES, 2023)

Research question

Can trade policies impact the use of irrigation water [change irrigation practices] and contribute to a more sustainable water management?

How can the country use its trade policy instruments — tariffs, quotas, regional/bilateral agreements— to shift its demand for irrigation water.

Methodology

A computable general equilibrium (CGE) model of the Tunisian economy and counterfactual analysis.

→ model water as a constrained factor of production, alongside land, labor and capital.

→ simulate different trade policy scenarios

1st Science days
January 15 2026

Kekli Sarra
Water & Trade

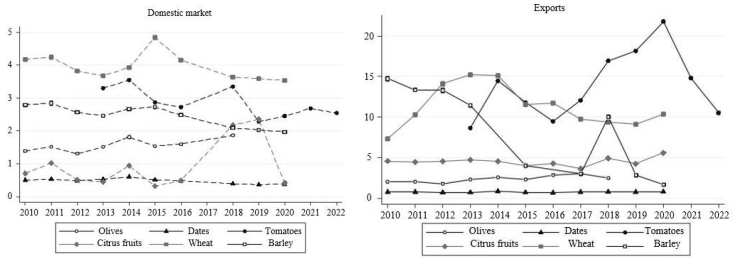
sarra.kekli@inrae.fr

Paper 1: linking data on agricultural production, trade flows, and blue water footprints, by product and by region.

Kekli, S., Cheptea, A. et LarocheDupraz, C.
(2024). Commerce international et utilisation de l'eau en agriculture : le cas de la Tunisie. MaghrebMachrek, 49-68. https://doi.org/10.54695/machr.260.0049.

Irrigation water footprint and the productivity of blue water in value terms by governorate in 2016

Region	Virtual water use (million m³)		Exported share (%)		Productivity of irrigation water in value terms (USD/m³)	
	associated to production	associated to exports	virtual water	production value	at producer prices	at export prices
Kébili	524,77	241,48	46	22	0,48	0,65
Sidi bouzid	161,97	90,16	56	39	2,33	6,17
Tozeur	152,14	69,95	46	22	0,64	1,45
Nabeul	129,63	19,70	15	22	9,53	22,05
Gabes	118,49	59,69	50	31	3,60	13,47
Sfax	72,25	51,61	71	52	3,84	9,35
Kairouan	68,99	16,63	24	26	6,64	12,54
Bizerte	53,87	17,42	32	19	15,33	28,49
Gafsa	29,62	13,63	46	41	0,10	0,13
Beja	29,43	11,30	38	27	19,64	36,81
Jendouba	31,37	7,32	23	18	4,94	14,66
Zaghouan	8,30	3,64	44	50	9,41	21,53
Siliana	7,78	3,26	42	38	10,11	24,81
Sousse	6,62	0,87	13	42	10,38	19,99
Kef	4,12	1,08	26	23	21,94	53,18
Monastir	1,85	0,03	2	64	5,65	22,01
Kasserine	0,18	0,02	11	40	2,71	7,43
Tunisia	1 410,54	612,15	43	33	13,55	28,35



Productivity of virtual blue water (USD/m³) : Domestic market and exports

1st Science days
January 15 2026

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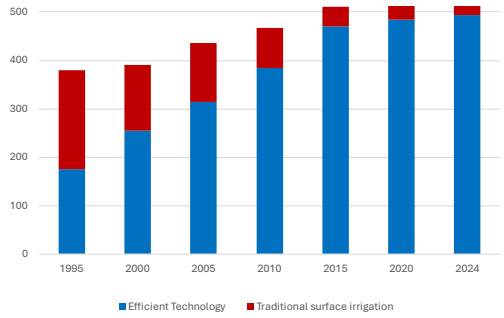
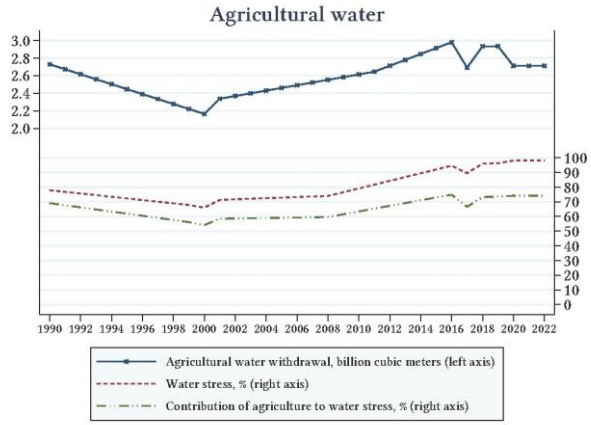
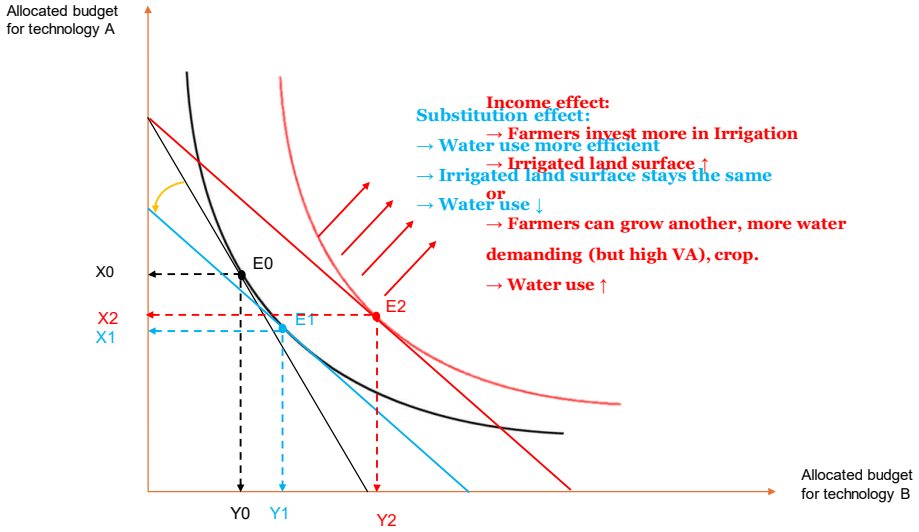




Evolution of irrigated land and efficient irrigation adoption from 1995 to 2024

Source: Authors' elaboration based on data from FAO STAT, Blinda (2009) and BPEH (2021, 2023)

Paper 2: Policy coherence and rebound effect



Posters Sustainable food systems

Valorization of sardine (Sardina pilchardus) fillet scraps and by-products generated during canning processing for the production of nutritional flour and oil intended to enrich foods

Hind MKADEM – IAV Hassan II

The aim of this study is to produce and characterize sardine (Sardina pilchardus) flour and oil from five different types of raw materials: whole fish, fresh by-products, cooked by-products resulting from filleting operations, mixed by-products, and sardine flesh. Three batches of sardines, caught at different times of the year (February, March, May), were used. The production of fish flour and oil was carried out using a wet pressing process, which included cooking, pressing and drying the solid paste for the flour, while the liquid separation phase was performed by decantation or centrifugation to extract the oil.

The results showed that the quality of the products strongly depends on the raw material used. The flour derived from sardine flesh exhibits the best characteristics, with a protein content exceeding 76%, low levels of free fatty acids, ash, and histamine, as well as a high content of polyunsaturated fatty acids (PUFAs), especially EPA and DHA. The oil extracted from this flesh is also of good quality, rich in PUFAs and compliant with standards for human consumption. Products derived from cooked filleting by-products also meet sanitary quality criteria and can be valorized for human consumption. Conversely, oils and flours from whole sardines or fresh by-products containing still viscera are not suitable for human consumption and can only be used for animal feed, despite the very satisfactory freshness of the raw material batches used.

This work highlights the potential of valorizing sardine flesh and cooked by-products to produce nutritious foods for human consumption, in the form of protein-rich flour and polyunsaturated oil

containing essential compounds, which can enrich many food preparations.

Valorization of sardine (*Sardina pilchardus*) fillet scraps and by-products generated during canning processing for the production of nutritional flour and oil intended to enrich foods

H. MKADEM [1]

[1] Institut Agronomique et Vétérinaire Hassan II – Rabat, Maroc.

TSARA 1st Science Days

1- Introduction

The Moroccan fishing industry, a key pillar of the national economy, is dominated by sardines (Sardina pilchardus). Its industrial processing, particularly during canning, generates up to 70% (by weight) of co-products, which are often valorized for animal feed. From a sustainability perspective, valorizing these residues helps reduce environmental impact while increasing the added value of the sector through circular economy practices. Rich in high-quality proteins and essential fatty acids (EPA and DHA), these co-products can be transformed into high-nutritional-value flours and oils.

This study aims to characterize these derivatives physically and chemically, intended for human consumption, demonstrating that co-products derived from cooked fillets meet the requirements for human consumption.

2- Materials and Methods

Biological Material: Three lots of fresh sardines (Sardina pilchardus) caught in Dakhla during different seasons (February, March, and May) to evaluate the impact of seasonality.

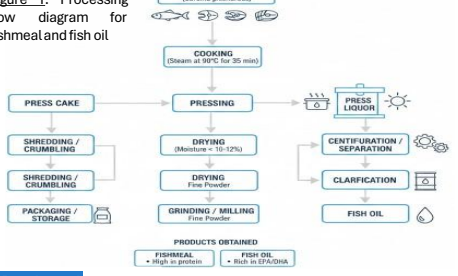
Sampling : WS : Whole Sardine; FB : Fresh By-products ; CB : Cooked By-products; MB : Mixed By-products; F: Fillets /Flesh

Table 1. Analysis conducted on fishmeal and fish oil

Farine de poisson	Huile de poisson
Proteins (AOAC, 2000)	Total aftty acids (Hammond, 1986)
Total fat (AOAC, 2000)	Peroxyde value (ISO 3960:2009)
Moisture (AOAC, 2000)	Anisidin value (ISO 6885:2016)
Ash (AOAC, 2000)	Acidity (ISO 660:2011)
Fatty acids(Hammond, 1986)	
Histamin (TVN)	

Statistical analysis : One-way analysis of variance (ANOVA) and a Tukey post-hoc test were performed using SPSS 21.0 (Statistical Package for Social Sciences), p compared to 0,05. All analyses were performed in triplicate and are presented as means ± standard deviation.

Figure 1. Processing flow diagram for fishmeal and fish oil







3- Results and discussion

Table 2. Physico-chemical properties of sardine meal

	Histamin (ppm)	TVN (mg/100g)	FFA (%)	Ash (%)	Moisture (%)	Fat (%)	Proteins (%)
MB	28.9 ± 1.9	131.8 ± 0.5	5.6 ± 0.4	25.7 ± 0.0	10.6 ± 0.3	8.8 ± 0.1	53.1 ± 1.0
CB	16.7 ± 1.7	58.4 ± 0.7	4.8 ± 0.6	24.6 ± 0.1	9.8 ± 0.1	8.2 ± 0.1	57.1 ± 1.1
FB	26.9 ± 1.8	62.8 ± 0.2	7.9 ± 0.4	23.2 ± 0.1	10.2 ± 0.1	9.5 ± 0.5	55.1 ± 1.3
WS	20.3 ± 0						5.2 ± 1.1
F	13.6 ± 1						7.6 ± 1.4

Table 3. Characteristics of fish oil depending on type of raw material

	Peroxyde value (meq O_2/kg)	Anisidin value	Acidity (%)	EPA (%)	DHA (%)
MB	10.1 ± 0.0	10.9 ± 0.3	4.7 ± 0.8	22.3	2.1
CB	4.2 ± 0.3	3.6 ± 0.4	1.3 ± 0.2	21.9	7.4
FB	8.3 ± 0.3	9.1 ± 0.1	5.9 ± 0.1	21.3	0.7
WS	5.1 ± 0.1	8.5 ± 0.1	2.5 ± 0.4	22.4	8.2
F	2.2 ± 0.6	4.2 ± 0.1	1.3 ± 0.3	23.6	7.9

4- Conclusion

- ✓ The flour derived from sardine fillets (F) had the best nutritional characteristics, with a protein content exceeding 76%.
- ✓ lours from cooked fillets (F) and by-products (CB) showed very low histamine levels (10.6 to 17.6 ppm) and a reduced TBV (22.4 to 32.4 mg/100g), ensuring high sanitary quality.
- ✓ The ash content varied from 4.4% (fillets) to over 20% for byproducts rich in bones (CB)
- ✓ Strongly linked to the fish's fat content, which varies seasonally (notably higher yield in May).
- ✓ The oils are exceptionally rich in polyunsaturated fatty acids: EPA (19% to 23%) and DHA (up to 9.8%).
- ✓ The oil from fillets (F) shows the best stability, with a peroxide value of 2.42 meq O_2/kg.

Suitability for Human Consumption	Only flours and oils derived from fillets and cooked by-products are suitable for human consumption.
Limitation	Fresh and mixed by-products containing viscera are considered unfit for direct human consumption due to microbiological risks and food safety regulations (e.g., FDA), but they can still be valorized for animal feed.
Impact	This process allows up to 52% of the sardine by-products weight to be transformed into high-value ingredients, supporting a circular economy approach.

5- Contact

Pour des informations supplémentaires : h.mkadem@iav.ac.ma

The "Milk as a Driver of Development" International Meetings: Origins and Objectives

Said Bouhallab – INRAE

Developing countries represent 85% of the world's population. In some of them, chronic poverty, food insecurity, and the erosion of natural resources require significant efforts from governments and development agencies. This is particularly true for the so-called "least developed countries", where 75% of the population lives below the poverty line, and which are mainly located in Africa and South Asia. In many of these countries, dairy sectors play a crucial role. They are key to providing high-quality products that are accessible to all populations and territories, while generating income for many families without depleting natural resources. Milk therefore represents a powerful driver of sustainable development, particularly in countries of the Global South, requiring a specific approach to the dairy sector.

Based on this observation, the international meetings **"Milk as a Driver of Development"** were launched in 2014 in Rennes, France, through a joint initiative of INRAE and CIRAD. The main ambition of these meetings is to achieve better coordination of actions supporting dairy value chains and dairy products. The objective is to foster, edition after edition, local dynamics for the sustainable development of dairy sectors, as well as to build a responsive and supportive international multi-stakeholder network.

Following Rennes, Rabat, Dakar, and Tunis, the fifth edition will take place in Saly, Senegal, from 12 to 14 May 2026. The organisation of the editions, which bring together an average of 120 participants, is coordinated by an international scientific and organising committee, with the support of local research, training, and knowledge-transfer institutions (Agreenium in Rennes, IAV-Hassan II in Rabat, ISRA in Dakar, INRAT and OEP in Tunis, and ISRA in Saly). Beyond traditional scientific conferences and presentations, the meetings place strong emphasis on exchanges between stakeholders through the simultaneous organisation of an exhibition fair and field visits. For each edition, French-English translation is provided. The themes addressed in each edition are designed in response to the evolution of dairy sector models within an increasingly constrained, complex, and changing international context. The 2026 edition aims to bring together scientists, decision-makers, and local stakeholders around sustainable and inclusive solutions through four sessions focusing on West Africa, dairy markets, climate, and milk diversity.

Challenges:- how to identify and preserve the diversity of existing dairy farming models in developing countries threatened by globalization? how to stimulate reflection on sustainable development, adapted to the constraints of each country?
→INRAE-Cirad Initiative 2014: 1st International Meetings "Milk, Driver of Development," an Off-the-Beaten-Path Event

International & local committees; Scientific presentations, exhibition fair, visits; French/English. ≈ 120-130 participants



2014: Rennes, France
- INRAE, CIRAD, Corfilac (Italie)
- Agreenium, Région Bretagne, Rennes Métropole, Ille & Vilaine, Cooperatives and equipment manufactures



2019: Dakar, Senegal
- ISRA, CIRAD, INRAE
- Agreenium, Oxfam, Giz, PPZS, VSF International, Care, Univ. McGill, FAO



2017: Rabat, Morocco
- IAV Hassan II, INRAE, CIRAD, Agreenium, FAO, Fimalait
- Equipment manufacturers: Boccard, Coquard, TGE, Elecrem



2023: Tunis, Tunisia
- INRAT, OEP, INRAE, CIRAD,, IRESA, Idele, FAO
- Cniel, Natilait, Tsara, TransDairy Europe, Isolab , other companies



2026: Saly, Senegal
- ISRA, CIRAD, INRAE
- PAOLAO Project, Cniel and other in contacts

https://lait2026.colloque.inrae.fr

2026 Scientific sessions:
Dairy sector in Senegal and West Africa: crossed views
Dairy market and the place of livestock farmers: from local to global
Adapting to climate change: greenhouse gas emissions , water, environment
Milk diversity: processing, nutrition, safety and human health

Outcome:
• Strong South-North link • Systemic approach
• Multi-stakeholder dialogue

Using genomic information to characterise the adaptation and vulnerability of local European and sub-Saharan African cattle breeds to climate change

Dominique Ahouanhode – INRAE

Intraspecific domestic genetic diversity is one of the key levers for increasing the resilience of livestock farming systems in the face of climate change. Local livestock breeds, which are well adapted to their respective environments and farming contexts but nevertheless threatened by genetic erosion, represent valuable genetic resources that need to be preserved. To guide their conservation and use across different agroecological contexts, the main objective of my PhD research is to apply a comprehensive and generic approach to characterising current genetic diversity and producing vulnerability indicators (assessment of their conservation potential and prediction of their adaptation or maladaptation to climate change) in a panel of local cattle breeds living in temperate and tropical environments (European and sub-Saharan African cattle breeds).

Using next-generation genomic data (high-density genotypes and whole-genome sequences), my work aims more specifically to:

- gain a better understanding of the fine-scale evolutionary history of sub-Saharan African cattle breeds, with a particular focus on the Kouri breed, emblematic of Lake Chad, in order to better understand the past environmental context that shaped this breed;
- identify the genetic bases of current climate adaptation in African cattle breeds along an east–west climatic gradient, in particular by investigating genes under natural selection and associated with climatic variables;
- and estimate their genetic burden, as well as their potential for adaptation or maladaptation to future climatic conditions in Europe and Africa, by considering several climate scenarios and applying different statistical approaches.

Using genomic information to characterise the adaptation and vulnerability of local cattle breeds from Europe and sub-Saharan Africa to climate change

Dominique AHOUANHODE[1], Matthieu LESNOFF[1], Mathieu GAUTIER[2], Laurence FLORI[1]
[1] SELMET (Systèmes d'élevage méditerranéens et tropicaux), CIRAD, INRAE, Institut Agro Montpellier, Université de Montpellier)
[2] CBGP (Centre de Biologie pour la Gestion des Populations), CIRAD, INRAE, Institut Agro Montpellier, Université de Montpellier)
Contacts: dominique.ahouanhode@inrae.fr & laurence.flori@inrae.fr

- Local cattle breeds source of genetic diversity (e.g., well adapted to their environment)
- Evolutionary history (demography, domestication, adaptation, artificial selection) has shaped the current diversity of livestock.
- However, this diversity is threatened by genetic erosion resulting in particular from uncontrolled crossbreeding (e.g. in extensive production systems and by the widespread introduction of exotic breeds) (FAO, 2019)

→

- Necessity to produce knowledge on current local breed genetic diversity and their future adaptive potential
- Maintain diversity to adapt to climate change



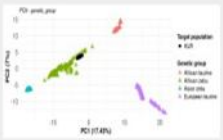
Kuri (Tchad), P.Souvenir, Borgou (Benin), Bayo C, Zebu Fulani (West Africa), Lagune(Benin), Thevenon S, N'dama(West Africa) , Berthier D

Thesis goal: Decipher local breed cattles past evolution and predict their vulnerability to climate stressors using genomic approach
⇒ Guide their management in different agro-ecological contexts

Thesis objectives

Objective 1: Demographic and Adaptive History of local cattle breeds (e.g., Kuri)

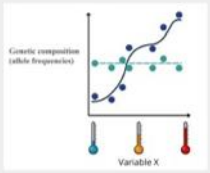
1. Exploration of the global cattle genetic diversity structure



2. Demography inference of Kuri cattle
3. Kuri adaptative history

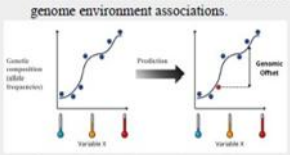
Objective 2: Genetic basis of the current adaptation of some local cattle breeds from Eastern-Western african transect

1. **Selection Signatures:** Detect genes shaped by natural selection or breeding practices.
2. **Genome Environment Associations:** Identify candidate loci linked to climate adaptation in African cattle.



Objective 3: Vulnerability of local cattle breeds from Sub-Saharan Africa and Europe to climate change (genetic load, genomic offset)

1. **Genomic Offset & Adaptation:** Predict adaptation or maladaptation of European and African local breeds under current and future environmental conditions using genome environment associations.



2. **Genetic Load & Vulnerability Indicators:** Estimate deleterious mutation to produce vulnerability indicators for conservation and management.

Assesment of Coffee Houses Business in Addis Ababa: Post COVID-19 Marketing Trend

Molla Mekashaw – Addis Ababa University

Introductions : Following COVID-19, people were joining with different small businesses across the world. The significant increment of digital connection among people contributes for resource utilization and innovation for different business entities. Coffee shopping business passion is one of widely emerged business area in Ethiopia after COVID-19 though it was before. It boosts dramatically every corner of the city in Addis Ababa. However, this business nature and marketing status not well documented yet.

Objectives : The main objective of this study was to assess coffee shops business based on market status and competition challenges in Addis Ababa, Ethiopia.

Methods : A cross-sectional study design with structured questionnaire was implemented to assess the coffee shop market and competition status in Addis Ababa. About 30 coffee shop managers/supervisors/baristas were interviewed to answer the objective of this study. To present the findings descriptive statistics used on Microsoft excel.

Results: More than 80% participants were managers and supervisors of coffee shops. Majority of participants were males. No participant below 25 years old and above 60 years old. One third of coffee shop business in Addis Ababa were opened after COVID-19. Majority coffee shops had 100,000 ETB-1,000,000ETB for startup capitals. Whereas the daily sales rate averagely range from 10,000ETB to 30,000ETB. Startup capital was directly related with daily sales rate and inversely related with breakeven time. With interviewee best guess, there is a coffee shop within 340m radius of their coffee house.

Conclusions : The marketing potential of coffee shop business was high with rapid expansion. Following COVID-19 epidemic, the coffee business increased with high rivals of among competitors. Even though high opportunity of market from customer side, there is no special attention from concerned bodies of the sector and strategic plan from the partitioners. The compotation atmosphere of this business was not inviting among owners.

Background: The Ethiopian coffee is the major agricultural exporting item in the country which highly supports the nation as hard currency source. Now adays, it becomes also the emerging business of traditional coffee shop/house especially in Addis Ababa starting from clay cattle to advanced hotel standard level. Following COVID-19, rapid expansion of coffee house business rebealed with under documented marketing status

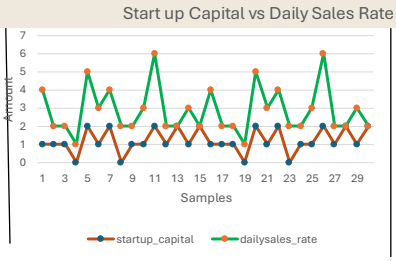
Objective: to assess coffee shops business based on market status and competition challenges in Addis Ababa, Ethiopia

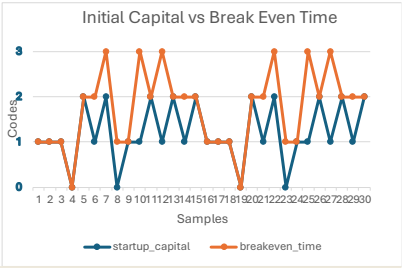
Methods: Cross sectional study design applied with structured questionnaire. All coffee shops before COVID-19 and after COVID-19 were interviewed. Descriptive analysis.

Table : Participants demographic characteristics in selected coffee houses in Addis Ababa, 2024

Position	N	%	Sex	N	%	Age	n	%
Baresta	4	13.33	F	14	46.67	<25	0	0
Manager	12	40.00	M	16	53.33	26-40	20	66.67
Supervisor	12	40.00	Total	30	100.00	41-60	10	33.33
Waiter	2	6.67				>60	0	0
Total	30	100				Total	30	100

Findings: There was no coffee house established during COVID-19 time. One third of coffee houses established after COVID time and others were established before (2/3 about a century business period start up)





Discussion and Recommendations

Coffee house business became one of among the most common business sectors chosen by traders post COVID-19 in Addis Ababa. It runs in an average of 50-meter distance each other following main streets. Most of coffee shop businesses started with out marketing analysis before their start up. In average the daily sales rate of coffee houses in Addis Ababa ranged from 10,000 to 30,000ETB.

- Training and innovation
- Strategic plan and Trade Partnership

Saloomh T. et al: Independent Coffee Shops and Cafes: Creating Unique Environments and Services capes, Marketing and DesigService Sector, 21–33 Copyright © 2024 by Emerald Publishing Limited; doi:10.1108/9781-83797-276-020241003

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Emergence of cowpea bacterial blight in Burkina Faso – NIEBABU

Newinyele Euvarise Some – INERA

Native to tropical Africa, cowpea (Vigna unguiculata L.) is a key legume in sub-Saharan Africa, particularly in Burkina Faso, where it plays an important role in combating food insecurity. However, a recent outbreak of cowpea bacterial blight has been observed in several production areas and seed stations, causing significant losses.

In the frame of the TSARA-funded project NIEBABU (Epidemiology of cowpea bacterial blight in Burkina Faso), we have built a new collaboration between France and Burkina Faso to characterize this disease and propose appropriate control methods. We performed three types of analyses:

- Impact of the disease across six provinces from Burkina Faso, in fields where cowpea was either in pure culture or in combination with other crops. These surveys were done in 2022, 2023 and 2024, on more than 5,000 plants in total. This showed that intercropping cowpea with maize reduces global disease incidence, while an association with common bean aggravates it.

- Research for resistance of Burkinabè cowpea varieties to Xanthomonas citri pv. vignicola, the agent of cowpea bacterial blight according to literature. Greenhouse experiments using three X. citri pv. vignicola strains on 12 cowpea varieties showed that despite most varieties being susceptible, two varieties were highly tolerant or resistant. This showed that local varieties can be used as sources of genetic resistance to limit the proliferation of the disease.

- Isolation, molecular characterization and phenotyping of eight strains isolated from symptomatic cowpea leaves. Surprisingly, all strains were identified as X. citri pv. malvacearum, the causal agent of cotton bacterial blight. This finding suggests that these bacteria acquired the ability to infect cowpea via cross-species transmission from neighboring cotton fields. By investigating the genome of these strains in relation to their ability to infect cotton and cowpea, our analyses provide insights into the molecular determinants of this presumed host shift.

In all, the NIEBABU project highlighted X. citri pv. malvacearum as being the potential agent responsible for an important disease outbreak on cowpea in Burkina Faso. This finding raises new concerns in terms of epidemiological surveillance and genetic management of the disease, both in Burkina Faso and in neighboring countries producing cotton and cowpea.

Emergence of cowpea bacterial blight in Burkina Faso

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Background

Native to tropical Africa, cowpea (*Vigna unguiculata* L.) is a key legume in sub-Saharan Africa, particularly in Burkina Faso, where it plays an important role in combating food insecurity However, a recent outbreak of cowpea bacterial blight has been observed in several production areas and seed stations, causing significant losses. However, the responsible agent for cowpea bacterial blight, *Xanthomonas citri* pv. *vignicola*, had never been described in Burkina Faso.

OBJECTIVE characterizing cowpea bacterial blight in Burkina Faso in order to propose appropriate control methods

Searching for resistance to *X. citri* pv. *vignicola*

We used reference strains CFBP 7111, CFBP 7112, and CFBP 7113 of *X. citri* pv. *vignicola* to phenotype 12 commercial cowpea genotypes under greenhouse condition.

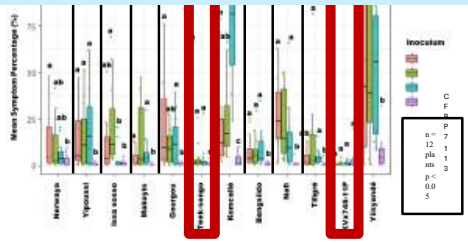


Fig 1. Symptom levels observed for each cowpea genotype after inoculation of *X. citri* pv. *vignicola*. Symptoms were evaluated 21 days after inoculation with strains CFBP 7111, CFBP 7112 or CFBP 7113. Inoculation was performed by rubbing of the first trifoliate, at a concentration of 1 × 10^8 CFU·mL^{-1}. SDW: sterile distilled water was used as negative control. Symptoms were quantified by machine learning-based imaging using ilastik v.1.3.3 (Berg et al., 2019).

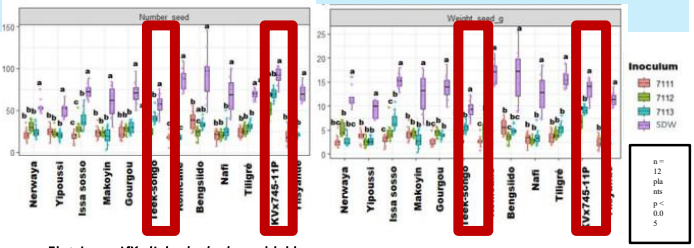


Fig 2. Impact of *X. citri* pv. *vignicola* disease on yield
The same plants as presented in Fig. 1 were grown to seed maturity (60 to 75 days). Then, pods were harvested and dried. After drying, pods were shelled and seeds were counted and weighted.

Genotypes Teek-songo and KVx745-11P presented high levels of resistance to the disease and their seed production was less impacted than the other genotypes (Some *et al.*, 2026) https://academicjournals.org/journal/AJAR/article-full-text-pdf/164DFAB74154

Impact of intercropping on the disease

A field survey was conducted in 6 provinces under different climates. For each region, and different crop combinations with 15 production plots of at least 0.5 ha (5 in monoculture, 5 in association with common bean, and 5 in association with maize).

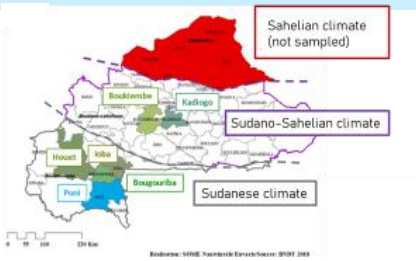


Fig. 3 Mapping representation of the prospecting and collection area

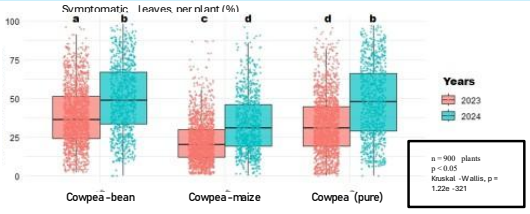
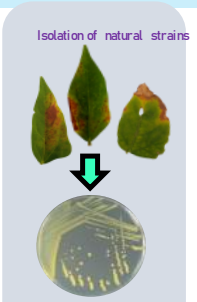


Fig 4. Mean incidence of bacterial blight of cowpea in 2023 and 2024 across intercropping types
For each plot, the incidence was estimated by counting the percentage of diseased leaves on 30 plants spaced 5 steps apart along the two diagonals of the field.

Disease incidence and severity varied depending on the crop combination. Combination with maize reduced symptom incidence



8 strains → Nanopore sequencing

Characterization of causal strains from Burkina Faso

Eight strains isolated from symptomatic cowpea leaves were characterized by PCR as Xanthomonadaceae (*rpfB* gene) possessing a type III secretion system (*hrcV* gene). These strains were sequenced and phenotyped on cowpea genotype Komcallé. The genome was composed of a chromosome of ~5Mbp and five diverse plasmids (15 to 56kb).

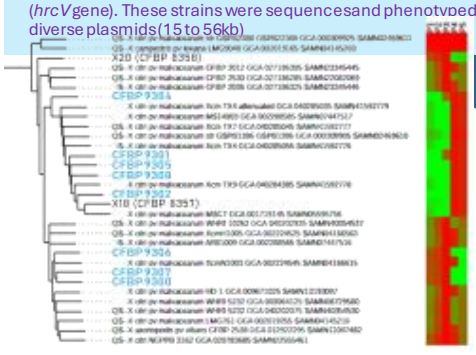
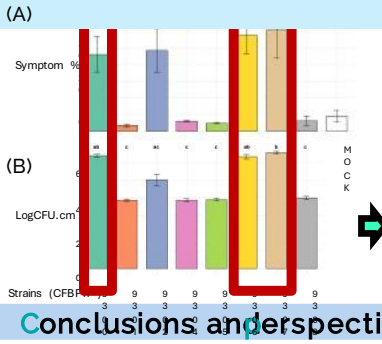


Fig 5 Phylogenetic position of isolated strains
A phylogenetic tree was constructed using RaxML on the core genome of all complete genomes from *Xanthomonas* strains present in the NCBI, plus our 8 strains isolated on cowpea (in blue). The presented subtree corresponds to *X. citri* pv. *malvacearum*. The heatmap on the right represents the presence-absence of plasmids.



The isolated strains were pathogenic on cowpea. Symptom severity and bacterial growth were associated to the presence of plasmids P4 and P5.

The strains isolated on cowpea were not *X. citri* pv. *vignicola* but belonged to *X. citri* pv. *malvacearum*, the agent of cotton bacterial blight.

Conclusions and perspectives

Our results indicate that *X. citri* pv. *malvacearum* is the potential agent responsible for an important disease outbreak on cowpea in Burkina Faso, which is suggestive of a recent host shift from cotton to cowpea. This finding raises new concerns in terms of epidemiological surveillance and genetic management of the disease, both in Burkina Faso and in neighboring countries producing cotton and cowpea.

TSARA Transforming food systems and agriculture through research in partnership with Africa
1rst Science day
January 15th 2026
IRHS Institut de Recherche et Horticulture et Semences
INRAE L'INSTITUT agro Rennes Angers
université angers
Cirm CIRAD - Bactéries associées aux plantes
PHENOTIC SEMENCES & PLANTES
L'INSTITUT agro Fondation

SESSION 3: INTERACTIONS AGROECOLOGICAL TRANSITION - SUSTAINABLE FOOD SYSTEMS

Session chair: **Awa Diattara, UGB, Senegal**

Parallel session A - Territory (local, political, etc.)

Chaired by **Zoubir Chattou**, ENA Meknès, Morocco

Parallel session B - Approach (modelling, monitoring, resilience)

Chaired by **Tobi Akinropo**, Obafemi Awolowo University (OAU), Nigeria

Speakers, institutions & concerned countries

Getachew Woldemedhin DAGNE, Salale University, College of Agriculture and Natural Resource, Fitche, Ethiopia
Raphael BELMIN, Cirad, Senegal
Pape Bilal DIAKHATE, ISRA, Senegal
Eveline COMPAORÉ SAWADOGO, INERA, Burkina Faso
Eric VALL, CIRAD, Benin, Côte d'Ivoire, Burkina, Mali
Noé DANIEL NGUYEN, Institut Agro Rennes-Angers, Morocco
Léon BICKEL-PASCHE, Institut Agro Montpellier, Namibia
Daouda NDIAYE, Cirad, Senegal
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Posters, authors, institutions & concerned countries

Eric VALL, CIRAD, Sénégal, Benin
Elias SHIFERAW, AAU, Ethiopia
Fatimatou Zahra NDOYE, Institut Agro Montpellier, Senegal
Eniyew ABEBAW, AAU, Ethiopia
Matilda FRIMPONG, INRAE - CSIR, Ghana

Parallel session A – Territory (local, political, etc.)

Dynamics, Drivers, and Impacts of Land Use and Land Cover Changes in the East African Highlands: A Systematic Review and Meta-Analysis with Evidence from Ethiopia

Getachew Woldemedhin Dagne

Salale University, Ethiopia

Over the past five decades, land use and land cover (LULC) changes have become a pressing environmental challenge in Ethiopia, with far-reaching implications for climate, biodiversity, ecosystems, and livelihoods across the wider Eastern Africa region. Ethiopia's diverse ecological zones and heavy reliance on natural resources make it highly susceptible to the impacts of LULC transformations, which are driven by rapid population growth, agricultural expansion, deforestation, urbanization, and climate variability. While numerous studies have examined these dynamics, much of the evidence remains fragmented and localized, providing limited insight into national-scale trends or their regional relevance. This study bridges that gap by conducting a systematic review and meta-analysis of empirical LULC research in Ethiopia, synthesizing findings to identify common patterns, underlying drivers, and consequences. The results reveal consistent conversion of forests, grasslands, wetlands, and bush-lands into cropland, agroforestry systems, plantations, and expanding settlements. These changes threaten Ethiopia's food security, water systems, and ecosystem services while also influencing trans-boundary resources and environmental stability across Eastern Africa. The study highlights the urgent need for integrated land use planning, sustainable agricultural intensification, and resilient urban development strategies. By advancing such approaches, Ethiopia can not only safeguard its own natural resources but also contribute to regional sustainability and environmental security in Eastern Africa.



Outline

* **Background**
  * **Global and African Context**
  * **Ethiopian Context and Research Gaps**
  * **Study Objectives**
* **Methodology**
  * **Data Collection**
  * **Meta-Analysis Approach**
* **Results**
  * **LULC Dynamics**
  * **Watershed-Level Findings**
  * **Drivers and Impacts of LULC Change**
* **Conclusions & Recommendations**

LULC: Global and African Context

* LULC change is a major global environmental challenge
* Strong links with climate variability, ecosystem services, and human wellbeing
* Global drivers: urbanization, agricultural expansion, deforestation
* Africa: heavy dependence on natural resources
* Key pressures:
  * Population growth
  * Food insecurity
  * Land degradation
  * Climate variability
* Unsustainable land use driven by poverty and weak governance

Ethiopian Context and Research Gaps

- Ethiopia hosts:
  - 10 ecosystems
  - Multiple agro-ecological zones
  - Two global biodiversity hotspots
- Ongoing initiatives: Climate Resilient Green Economy
- Key research gaps:
  - Localized focus
  - Limited integration of socio-economic & climate factors
  - Weak attention to governance and cultural practices
  - Few meta-analytic studies

Study Objectives

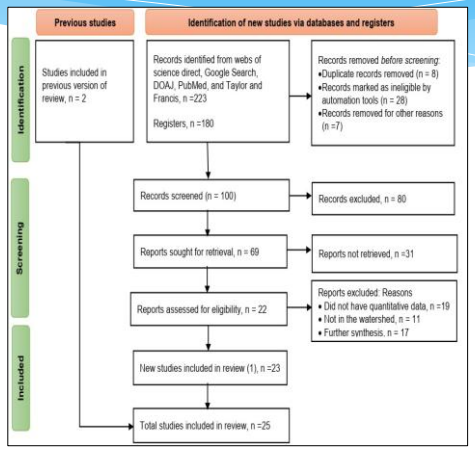
- Conduct a **systematic review and meta-analysis** of LULC changes in the watershed
- Quantify:
  - Spatial and temporal LULC dynamics
  - Drivers of change
  - Environmental and socio-economic impacts
- Provide nationally relevant, policy-oriented evidence

1st Sciences Days January 20, 2026 Woldemedhin Dagne Getachew E-mail: dagne.getachew2@gmail.com Dynamics, Drivers, and Impacts of LULC: Evidence from Ethiopia

Methodology

Data Collection

* Followed **PRISMA guidelines**
* Keywords focused on:
  * LULC change
  * Deforestation
  * Vegetation and forestry in Ethiopia
* Meta-analysis studies:
  * **25 watershed-based studies**



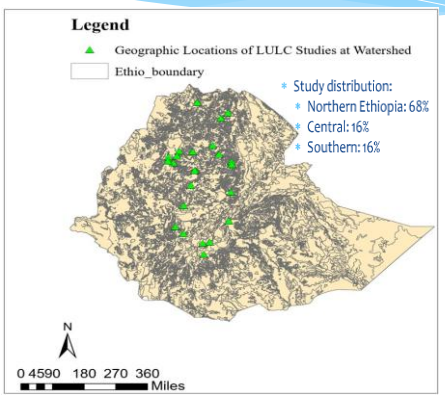
Meta-Analysis Approach

* Effect size measured using **Hedges' g**
* Random-effects model applied
* Statistical tools:
  * SPSS (descriptive analysis)
  * Jamovi (meta-analysis)
  * ATLAS.ti (narrate drivers & impacts synthesis)
* Tests conducted:
  * Heterogeneity (Q, I^2, tau^2)
  * Forest plot
  * Funnel plot (publication bias)

Results

LULC Dynamics

* Significant difference between land use (LU) and land cover (LC):
  * **LU increased by ~55%**
  * **LC declined by ~81%**
* Mean area change:
  * LU: +10,153 ha
  * LC: −5,815 ha
* Agricultural land shows the largest increase
* Natural land covers show consistent decline



Watershed-Level Findings

* **The effect of LULC at watershed is high and homogeneous**
* Land use trends:
  * Agriculture ↑
  * Agroforestry ↑
  * Plantation ↑
  * Settlement & built-up ↑
  * Grazing land ↓
* Land cover trends:
  * Forest ↓
  * Bush land ↓
  * Grassland ↓
  * Water bodies ↓
  * Bare land ↑

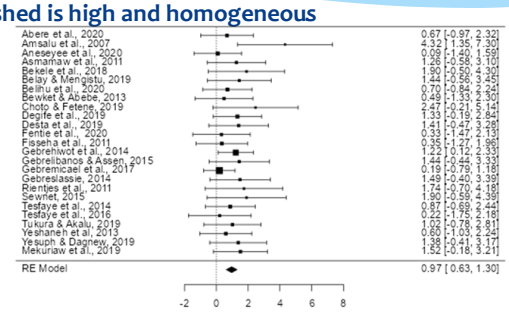


Figure 3 Forest plot

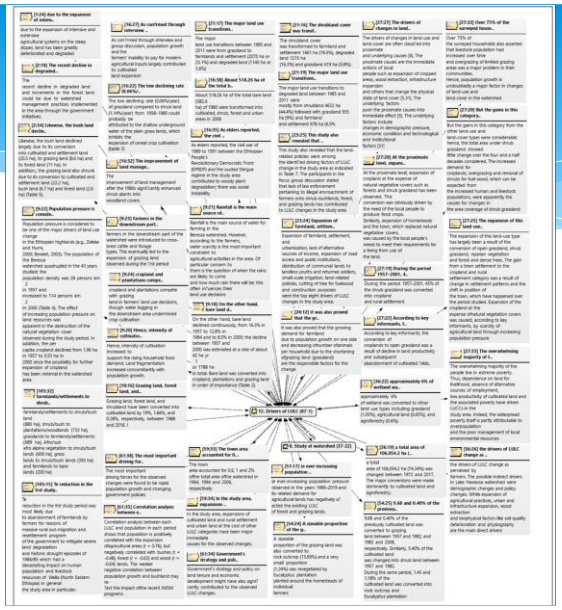
Drivers and Impacts of LULC Change

Main Drivers

- Agricultural expansion
- Population growth
- Urbanization
- Livestock pressure
- Policy and political changes

Major Impacts

- Environmental:
  - Sedimentation
  - Hydrological alteration
  - Biodiversity loss
- Socio-economic:
  - Food insecurity
  - Reduced crop & livestock productivity
  - Loss of ecosystem services



Conclusions & Recommendations

- **Conclusions**
  - Clear shift from natural land cover to human -dominated land use
  - LULC effects are large, homogeneous, and widespread across watersheds
  - Agriculture is the dominant driver
- **Recommendations**
  - Delineate land for agriculture and settlement
  - Promote vertical intensification (agricultural & architectural technologies)
  - Strengthen land use policy implementation
  - Integrate socio-economic, governance, and climate dimensions
  - Further policy-focused and methodologically innovative research

1st Sciences Days January 20, 2026 Woldemedhin Dagne Getachew E-mail: dagne.getachew2@gmail.com Dynamics, Drivers, and Impacts of LULC: Evidence from Ethiopia

Patrimoine agroécologique et transition territoriale : enseignements de la dynamique PRATAM en Basse-Casamance

Raphaël Belmin

Cirad, France

Dans de nombreux territoires africains, l'agroécologie reste enfermée dans une logique « par projets », caractérisée par des interventions courtes, des financements externes et une approche techniciste de l'innovation. Cette configuration génère certes des améliorations ponctuelles, mais empêche des transformations socio-politiques et institutionnelles profondes, pourtant indispensables pour rendre les systèmes agri-alimentaires plus écologiques, justes et résilients. En cherchant à dépasser cet écueil, nous avons porté notre attention sur des territoires dotés de formes d'agroécologie endogènes, historiquement ancrées, qui résistent, se transmettent et se transforment indépendamment de l'influence de projets. La Basse-Casamance, au Sénégal, en constitue un exemple saisissant. Son enclavement relatif et la vitalité de ses institutions coutumières en font un espace de résistance face à l'extractivisme néo-libéral, où se déploient des voies d'agroécologisation fondées non pas sur des paquets techniques exogènes, mais sur la mobilisation des ressources matérielles et immatérielles déjà présentes dans le territoire.

La dynamique de recherche-action PRATAM (Potentiels de Résilience et d'Autodétermination des Territoires Agroécologiques Menacés) vise à caractériser le Patrimoine AgroEcologique (PAE) de la Basse-Casamance, à analyser les menaces qui pèsent sur lui et à accompagner les acteurs locaux dans sa qualification, sa reconnaissance, son maintien et sa valorisation. Par PAE, nous entendons l'ensemble dynamique de pratiques, de savoirs, de paysages, d'institutions et de valeurs qui relient les sociétés humaines à leurs milieux de production et de subsistance, au sein d'un territoire. Le PAE englobe un ensemble d'entités hétérogènes qui caractérisent un rapport Humain-Terre spécifique: Riziculture de mangrove, pêche, cueillette de produits forestiers non ligneux, plats cuisinés, forêts et arbres sacrés, rites… en Basse-Casamance, ces entités sont inscrites dans un système complexe de relations - elles forment une véritable écologie – qui fonde la résilience alimentaire et écologique du territoire face aux menaces en cours.

Née en 2024 avec l'appui d'une grappe de projets incubateurs (TSARA, FEF DyTAES, ASA NBS, ACROPICS, Safoods), la dynamique PRATAM fédère un collectif interdisciplinaire et structure un partenariat Nord-Sud (CIRAD, INRAE, UASZ, ISRA, UNIB, CREATES) autour d'une double démarche : (i) d'une part, il s'agit de qualifier le PAE de Basse-Casamance, envisagé comme un héritage fragile dont il faut comprendre la composition et les vulnérabilités. Cela implique un travail d'inventaire et d'analyse des menaces qui pèsent sur ses différentes entités, pris en charge par un postdoc appuyé par deux prestataires ; (ii) d'autre part, le PAE est mobilisé comme matrice pour co-concevoir et déployer un futur désirable pour un territoire, au travers d'activités à vocation transformatives. En 2025, les acteurs du territoire ont été réunis dans le cadre d'un atelier d'idéotypage qui a permis de formuler collectivement une « Vision Casamance 2050 », devenue la boussole politique du dispositif. Cette vision a servi de levier à la construction d'une coalition territoriale en mai 2025 : la Dynamique pour une Transition Agroécologique Locale (DyTAEL) d'Oussouye. Deux ateliers successifs (juillet et octobre 2025) ont consolidé cette coalition, à travers l'appropriation de la vision, la définition des attentes envers la DyTAEL, et enfin un backcasting pour traduire la vision 2050 en plan d'action.

Les résultats intermédiaires de la phase d'incubation montrent une dynamique désormais solide et activable : Une dynamique PRATAM structurée par un consortium scientifique, moteur d'une plateforme territoriale établie. Le cadre conceptuel et analytique du PAE est stabilisé et prêt à être

déployé. Des cofinancements sécurisés jusqu'à fin 2026 garantissent la continuité de l'effort. La prochaine étape vise la montée en puissance d'un projet structurant articulant a minima : (i) une poursuite de l'inventaire du PAE comme socle méthodologique ; (ii) des approches cartographiques, historiques et prospectives visant à caractériser les transformations spatiales et temporelles du PAE ; (iii) des cas d'étude ciblés permettent d'analyser les trajectoires de certaines entités clés (ex : produits forestiers non-ligneux, riz, fromagers, bois sacrés) ; (iv) des approches audio-visuelles et créatives, visant à co-produire et diffuser des récits autour du patrimoine agroécologique, (v) un accompagnement des plateformes territoriales locales (DyTAEL) vers la mise en œuvre d'un projet de territoire.

Cette communication proposée pour les TSARA Science Days vise a faire connaître les principaux, enjeux et mode d'action de la dynamique PRATAM. Au-delà du cas spécifique de la Basse-Casamance, cette approche ouvre la possibilité d'études comparatives avec d'autres territoires, dans la perspective de bâtir une troisième voie pour la transition agroécologique : une transformation ancrée dans le patrimoine agroécologique vivant, pensé à la fois comme héritage à préserver et comme ressource pour projeter un futur commun.

DyTAEL Oussouye

PRATAM

Patrimoine agroécologique et transition territoriale : enseignements de la dynamique PRATAM en Basse-Casamance

Raphael Belmin, Bruno Turnheim, Alexandre Badiane, Joan Bastide, Patrick Bottazzi, Tidiane Sané



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PRATAM

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En Afrique, limites d'une agroécologie « par projets »



- **Le déploiement de l'agroécologie dépend souvent de projets :**
  - **Pensés** et mis en œuvre par des acteurs exogènes (ONG, etc.)
  - **Financés** par l'aide internationale et des réseaux transnationaux.
  - **Fondés** sur des référentiels de durabilité « hors-sol » (ex: FAO)
  - **Opérationnalisés** via des principes agroécologiques génériques et des paquets techniques mondialisés

- **L'agroécologie « par projets » et ses limites :**
  - Dépendance structurelle aux ONG, centres de recherche, etc.
  - Interventions courtes et peu coordonnées
  - Approche techniciste de l'innovation, techniques parfois inadaptées
  - Transformations socio-politiques et institutionnelles limitées
  - Déresponsabilisation des Etats et maintien de postures post-coloniales

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PRATAM

Des enclaves où persistent des relations humains -terres porteuses de nouvelles promesses



- **Certaines sociétés agraires** survivent et résistent en marge de la Modernité Industrielle, dans des lieux géographiquement enclavés (Raskin et al 2010).
- Elles se transforment rapidement sous l'influence de régulations globales, mais ont conservé une **capacité d'auto-détermination** fondée sur des liens forts avec la nature.
- **Ces territoires valent la peine d'être étudiées**
  - Pour en assurer la préservation.
  - Car elles représentent des formes d'agroécologie endogène
  - Car elles représentent des espaces de résistance voire de dépassement des écueils de la Modernité Industrielle.

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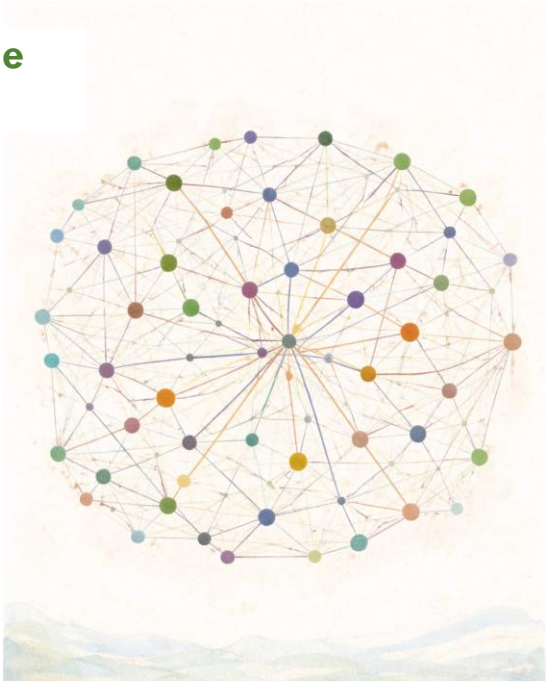
Basse-Casamance
une agroécologie « *de facto* »

- **Une société agraire ancienne** ancrée dans un écosystème de delta, alternant forêts nourricières, mangroves et riches plaines rizicoles.
- **Un tissu complexe d'activités** productives (riziculture, cueillette, pêche, etc..), récréatives et spirituelles.
- **Des relations humains-terre** régies par des institutions coutumières robustes, qui encadrent l'accès aux ressources naturelles et aboutissent au respect de toute formes de vie.
- **Un patrimoine agroécologique territorialisé**, temporairement protégée, mais menacé

Qu'entendons nous par **patrimoine agroécologique?**

- Un ensemble d'entités hétérogènes…..
- pratiques, produits, savoirs, paysages, institutions, de valeurs…
- inscrites dans un système complexe de relations, formant une véritable écologie….
- qui relient les sociétés humaines à leurs milieux de production et de subsistance, au sein d'un territoire….
- qui fonde la résilience alimentaire et écologique du territoire face aux menaces en cours.



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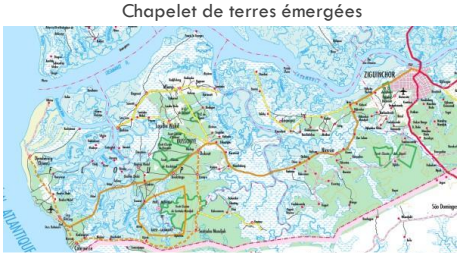
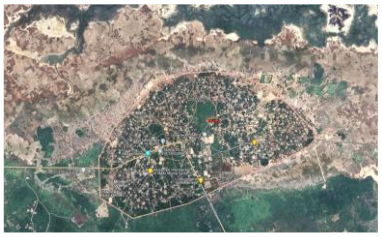
Région enclavée du Sud-Sénégal



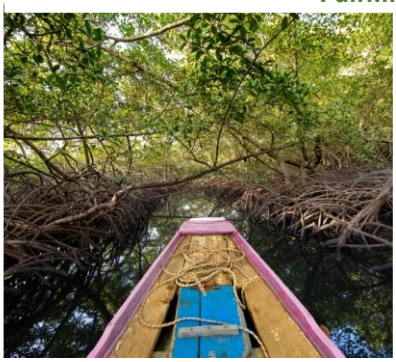
Chapelet de terres émergées



5 espaces multifonctionnels



Patrimoine agroécologique de Basse-Casamance



Ecosystèmes de mangroves



Riziculture endogène



Vitalité des institutions coutumières



Objectifs du PRATAM*

1 – **Caractériser le patrimoine agroécologique** de la Basse-Casamance, ses dynamiques de changement et ses mécanismes de résilience

2 – **Accompagner les acteurs locaux** dans sa qualification, sa reconnaissance, son maintien et sa valorisation

3 - **Lancer un débat** académique et socio-politique sur le patrimoine agroécologique

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PRATAM

Potentiels de Résilience et d'Adaptation des Territoires Agroécologiques Menacés

Dynamique d'incubation PRATAM

2023	2024	2025 T1	2025 T2&3
Identification de la Basse Casamance comme territoire agroécologique exceptionnel	Constitution d'un collectif de recherche, démarrage des travaux et montage de projets	Mobilisation des acteurs du territoire et construction d'un groupe d'experts	Structuration des dynamiques socio-politiques locales et exploration de nouveaux axes
ACTIVITÉS SCIENTIFIQUES			
- Mission exploratoire - Regard sur la Basse Casamance comme territoire agroécologique	- Mission exploratoire - 2 stages TSARA - Journées de l'agroécologie de Lausanne	- Mission de définition stratégie d'inventaire du patrimoine agroécologique	- Lancement inventaire - Recrutement postdoc + prestataires
RECHERCHE DE FINANCEMENTS			
- Dépôt projet TSARA - Fléchage projet ACROPICS	- Dépôt projets FEF - Dépôt projet ASA	- Fléchage projet Safoods - Fléchage projet LED	- Dépôt projets Belmont - Demande d'avenant TSARA
ACCOMPAGNEMENT DES ACTEURS DU TERRITOIRE			
		- Atelier d'idéotypage - Constitution groupe d'experts régional	- Lancement DyTAEL - Vision Oussouye 2050 - Backcasting - Structuration DyTAEL

TSARA

Inventaire du patrimoine agroécologique

- Liste des « entités »
- Fiches descriptive pour chaque entités
- Base de donnée et matrice des liens
- Mobilisation des acteurs dans l'inventaire





TSARA



Impulsion d'une dynamique territoriale

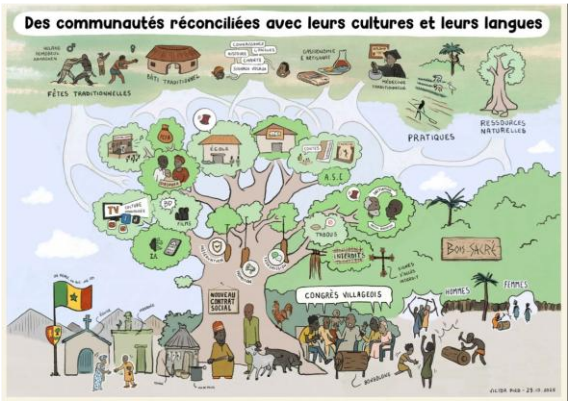
Mars 2025
Atelier d'idéotypage

Mai 2025
Caravane DyTAES
Lancement DyTAEL d'Oussouye

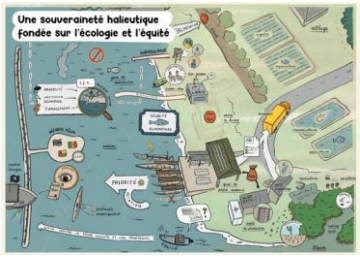
Juillet 2025
Adoption « Vision Oussouye 2050 »
Cartographie des acteurs

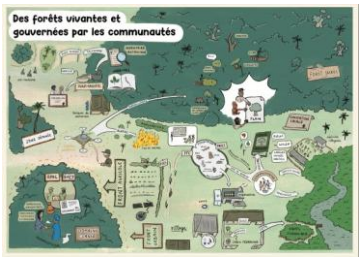
Octobre 2025
Structuration DyTAEL
Backcasting
Inventaire participatif

Vision Oussouye 2050











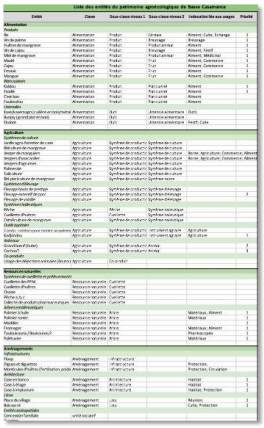
Quelques produits intermédiaires



4 rapports d'ateliers multi -acteurs



2 mémoires de stage



1 liste provisoire de 97 entités



23 fiches entités remplies



Vision Oussouye 2050

Bilan de la phase d'incubation

Résultats intermédiaires

- Un noyau de scientifiques Nord-Sud fédéré (6 org.)
- Une plateforme territoriale structurée (82 org.)
- Un groupe d'experts régional mobilisable
- Un cadre d'analyse et d'action stabilisé et déployable
- Processus d'incubation intégralement documenté

Perspectives : vers un projet structurant

- Des cofinancements sécurisés jusqu'à 2026 garantissant la continuité de l'effort
- Recherche de financements pour passer d'une grappe de projets incubateurs à un grand projet structurant



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PRATAM

Axes de travail futurs pour le PRATAM

1. L'inventaire du patrimoine agroécologique comme socle méthodologique
2. Caractériser les transformations spatiales et temporelles du patrimoine agroécologique (approches ethnographiques, cartographiques, historiques et prospectives)
3. Analyser les trajectoires de certaines entités clés (ex : produits forestiers non-ligneux, riz, fromagers, bois sacrés, maraichage)
4. Développer des stratégies d'activation, protection et adaptation du patrimoine agroécologique (approches audio-visuelles, valorisation des produits, apprentissage par le jeu)
5. Accompagner des plateformes territoriales locales (DyTAEL) vers la mise en œuvre d'un projet de territoire.
6. Comparaison avec d'autres territoires

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PRATAM

Job creation conditions in rice-growing areas engaged in the agroecological transition in Senegal: the case of the Senegal River Valley

Pape Bilal Diakhate

ISRA, Senegal

Recent studies show that agroecology contributes to improving farmers' working conditions by fostering professional fulfilment and strengthening women's empowerment. These effects are reflected in particular in the diversification of activities, greater recognition of women's roles in agricultural networks, and improved access to resources as well as decision-making arenas (FAO, 2024; Serpossian et al., 2022; Banda & Smith, 2024). However, several authors emphasize that the agroecological transition, despite its environmental and social benefits, also represents a constraint for farmers. It tends to increase labor requirements, the need for hired labor, and physical workload, particularly in farms with low levels of mechanization (Lucas & Gasselin, 2022; Chizallet, Prost & Barcellini, 2021; Springer, 2024).

This article examines the conditions under which agroecology fosters job creation in rice farming systems in the Senegal River Valley. Based on a survey conducted with 210 rice farmers, including farm managers, hired workers, and family labor, the results of the Heckman selection model reveal that labor costs constitute the main barrier to the adoption of agroecological practices. However, farmers' experience and access to mechanization emerge as key determinants of adoption. Furthermore, the analysis shows that increasing cultivated areas, combined with efficient management of production costs, is an essential condition for stimulating job creation in rice-growing areas engaged in the agroecological transition.



RESEARCH PROBLEM

At least two opposing perspectives emerge from the literature:

Agroecology is viewed as an opportunity to improve farmers' working conditions, particularly in terms of job satisfaction and women's empowerment (FAO, 2024; Serpossian et al., 2022; Banda & Smith, 2024). These improvements are reflected in:

the diversification of activities and crop production,

increased recognition of women's roles within agricultural networks,

improved access to resources.

Conversely, the agroecological transition is considered a constraint for farmers, as it increases labor requirements, labor demand, and physical workload, especially in low-mechanized farming systems (Lucas & Gasselin, 2022; Chizallet, Prost & Barcellini, 2021; Springer, 2024).

To what extent does agroecology promote job creation in rice-growing areas of the Senegal River Valley?

OBJECTIFS

General Objective

To analyze the conditions for job creation in agroecological rice-growing areas in the Senegal River Valley.

Specific Objectives

1. To characterize rice farming systems in the Lake Guiers area with respect to the adoption of agroecological practices;

2. To identify the factors influencing labor creation in agroecological rice production systems.

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INTEREST

Policy Relevance

Consideration of the System of Rice Intensification (SRI) as an adaptation option within Senegal's Nationally Determined Contribution (NDC);

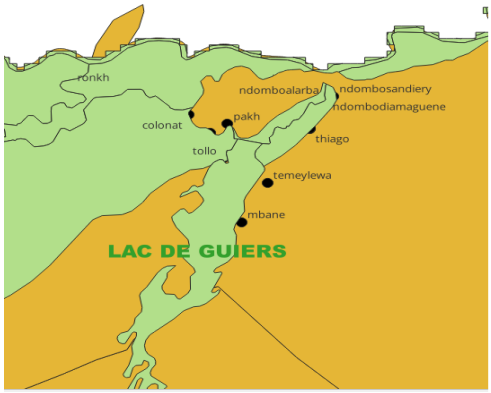
Scientific Contribution

Contributes to the literature on labor and employment in Francophone African countries;

Identifies the key factors explaining the conditions for job creation in agroecological farming systems;

Relies on quantitative data collected from workers in agricultural farms.

STUDY AREA



Communes du lac de Guiers (4)	Villages (12)	Producers/Workers (210)
Mbane	Thiago, Temey Thiago, Temey Lewa, Mbane	74
Richard Toll	Colonat, Richard Toll, Ndombo Alarba	31
Ronkh	Bountou Bath, Ronkh, Pakh, Tollo	79
Ndombo	Ndombo Sandiery, Ndombo Diamaguene	26

The surveys were conducted among 210 respondents:
Producers: questionnaire on work organization;
Workers: questionnaire on working conditions.

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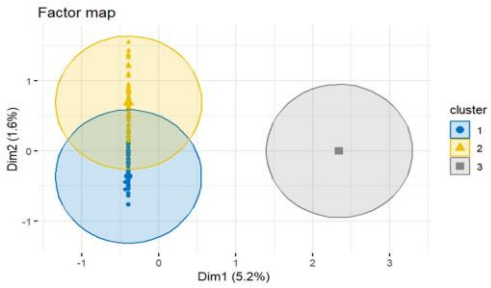
ANALYTICAL METHOD

M1: Multiple Correspondence Analysis (MCA): classification of rice producers according to the adoption of agroecological practices;

M2: Econometric estimation using the Heckman model: labor creation in agroecological rice farming systems.

RESULTS : CLASSIFICATION

AE practices considered
Biopesticides
Crop asssociation
Crop rotation
Crop residue management
Use og organic amendments
Minimum tillage
Fallow
Regular weeding
Minimal use water
Optimal plant spacing
Early seedling transplantation
Use of chemical fertilizers



Level 1 agroecological transition : $\boldsymbol{TAEN1}$
Level 2 agroecological transition: $\boldsymbol{TAEN2}$
Not agroecological : **NA**

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RESULTS : CLASSIFICATION

Characteristics	TAEN1	TAEN2	NA
Biopesticides	0.55%	3.35%	0%
Intercropping	6.14%	29.05%	0%
Crop rotation	21.22%	29.61%	0%
Crop residue management	8.38%	17.88%	0%
Use of organic matter	21.79%	27.37%	0%
Shallow tillage	25.14%	7.82%	0%
Fallow	5.59%	24.58%	0%
Regular weeding	21.79%	16.20%	0%
Minimal water use	1.12%	7.82%	0%
Optimal plant spacing	18.99%	17.32%	0%
Early seedling transplantation	3.35%	16.76%	0%
Use of chemical fertilizers	**55.02%**	29.67%	**14.35%**

RESULTS : CLASSIFICATION

Characteristics	TAE N1	TAE N2	NA	Test stats
Sample size	117	62	30	
Agricultural equipment	Manual and motorized	**Manual and animal-drawn**	Manual	***
Irrigation system	Flooding and drainage	**Furrow irrigation**	Flooding and drainage	***
Other crops	Market gardening and rainfed crops	**Market gardening and rainfed crops**	Absent	***
Age	Adult (52 years)	Adult (48 years)	Adult (53 years)	
Sex	Men	Men	Men	
Education level	None	**Primary**	Primary	***
Agricultural experience	28 years	**22 years**	25 years	*
Household size	10	**12**	9	**
Marital status	Married (monogamous)	**Married (polygamous)**	Married (monogamous)	**
Farm size (ha)	2.06	**2.49**	1.66	**
Commune	Ronkh	**Mbane**	Ndombo Sandjiry	*
Type of labor	Family and hired labor	**Family and hired labor**	Family labor only	***

Characteristics of farmers by level of adoption across communes

Communes	Classes		
	TAE N1	TAE N2	NA
MBANE	15.31	**18.66**	1.91
NDOMBO SANDJIRY	0.95	4.31	**6.69**
RICHARD TOLL	13.87	0.95	0.95
RONKH	**25.84**	5.74	5.74

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RESULTS : ESTIMATIONS/ADOPTION AE

Variable	TAE N1	TAE N2
Age of the household head	-0.017	—
	(0.01)	
Education level	**-0.676*** **	-0.006
	(0.21)	(0.00)
Household working on own account	**-0.713** **	—
	(0.35)	
Number of years of experience of the household head	**0.020** **	**-0.016** **
	(0.01)	(0.01)
Rice-specialized household	**0.550*** **	**-0.341***
	(0.20)	(0.22)
Household size	0.009	0.021
	(0.01)	(0.01)
Farm size (area)	0.063	—
	(0.06)	
Use of animal-drawn equipment	-0.287	**0.496***
	(0.28)	(0.30)
Use of motorized equipment	**-0.900*** **	**1.149*** **
	(0.27)	(0.27)
Number of hours of non-routine labor	-0.001	—
	(0.00)	
Number of hours of routine (on-call) labor	-0.006*	—
	(0.00)	
Constant	0.859	-0.841*
	(0.56)	(0.27)

Significance levels: *** p<0.01; ** p<0.05; * p<0.10.

RESULTS : ESTIMATIONS/LABOR INTENSITY

Variable	TAE N1	TAE N2
Sex of the household head	-2.604e+01	—
	(2.398e+01)	
Education level	2.597e+00	-2.262e+01
	(6.309e+00)	(1.369e+01)
Household size	9.901e-01	3.532e-01
	(5.205e-01)	(7.496e-01)
Number of years of experience of the household head	2.259e-01	**6.480e-01***
	(1.890e-01)	(3.901e-01)
Farm size (area)	**5.400e+00*** **	-3.413e+00
	(1.657e+00)	(2.127e+00)
Daily labor cost	**-9.389e-05***	**-1.627e-04***
	(5.373e-05)	(9.633e-05)
Number of hours of routine (on -call) labor	1.040e-01	—
	(9.599e-02)	
Use of animal -drawn equipment	1.037e+01	-6.883e+00
	(7.140e+00)	(1.218e+01)
Use of motorized equipment	**3.415e+01*** **	-4.772e+00
	(1.020e+01)	(2.076e+01)
Constant	3.589e+01	6.593e+01
	(2.525e+01)	(4.324e+01)

Note 1: Statistical significance at the 1% level is indicated by ***, at the 5% level by **, and at the 10% level by *.

Note 2: Values in parentheses represent standard errors.

RESULTS/WORK CONDITIONS

	Family Labor			Wage Labor		
Variables	**TAE N1**	**TAE N2**	**NA**	**TAE N1**	**TAE N2**	**NA**
Employment opportunity						
No (%)	0.46	0.23	0.20	0.50	0.27	0.13
Yes (%)	**0.024**	**0.061**	**0.012**	0.00	**0.090**	0.00
Autonomy						
No (%)	0.17	0.098	0.098	0.090	0.090	0.00
Yes (%)	**0.30**	**0.20**	0.12	**0.40**	**0.27**	0.14
Job satisfaction						
Low satisfaction (%)	0.00	0.043	0.00	0.18	0.18	0.090
Satisfied (%)	**0.52**	0.17	0.26	**0.31**	**0.18**	0.045

IMPLICATIONS

On the adoption of agroecological practices

- Improve the use of animal waste in rice farming systems;
  Maximize its utilization on agricultural land;
  Reduce losses of waste.
- Strengthen awareness of agroecological practices by:
  Organizing experience -sharing platforms among producers.
- Mechanize certain tasks specific to agroecology in order to:
  Increase efficiency;
  Reduce manual labor workload.
- Train and mobilize on -call labor to:
  Facilitate the adoption of agroecological practices;
  Ensure the effective integration of agroecological techniques.

On labor use

- Prioritize land development for producers adopting agroecological practices in order to:
  Encourage adoption by other producers;
  Stimulate labor demand.
- Make agroecological product prices more attractive by:
  Covering higher labor costs;
  Enhancing the market value of these products
- Increase workers' productivity by:
  Providing targeted training;
  Introducing appropriate agroecological technologies

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Understanding Agricultural labour in Burkina Faso: Looking at Gender Constraints and Satisfaction in Conventional and Ecological Rice Fields

Eveline Compaoré Sawadogo

INERA, Burkina Faso

Agricultural work in Africa in general, and Burkina Faso in particular, is largely dominated by high physical intensity, especially in family farming, where mechanization remains very low. Farmers face long working hours, repetitive movements, and risks related to climate and pesticides. This paper examines the working conditions in rice farms, looking at conventional and agroecological rice farms. It is believe that farmers often operate under difficult working conditions characterized by intense physical labor, limited access to resources, climatic risks, and economic instability. This study uses the Sustainable Livelihoods Framework as a theoretical framework using a qualitative approach to conduct a comprehensive data and analysis on working conditions in both conventional and ecological rice farms. It includes the cultural identity of men and women that impact how women and men navigate as workers in agricultural sector. The résults show that women are in the centre of rice production in terms of temporary as well as long time work delivering.Farmers' aspirations increasingly focus on modernization, including access to training, mechanization, irrigation technologies, and secure land tenure. They also seek better market opportunities and improved living standards. Overall, understanding these dimensions is essential for designing agricultural policies that enhance productivity, resilience, and the well-being of rural communities.

Projets : EmployAE et Santés & territoires

Understanding Agricultural labour in Burkina Faso : Looking at Gender Constraints and Satisfaction in Conventional and Ecological Rice Fields

Présentés par : **Eveline SAWADOGO/COMPAOREEveline**
INERA

Context

•Rice has become a major consumer product in Burkina Faso, but domestic production remains insufficient to meet demand, despite strong growth in production in recent years (MAAH, 2017)

•The government has implemented several strategies to develop the rice sector (including the SNDR), which has led to an increase in acreage and production.

•Consumption exceeds 400,000 tons per year and is growing rapidly, while local production covers less than half of the demand (FAOSTAT,2020).

•The economic contribution of the rice sector remains low and producers' incomes remain modest, despite the high number of people living off rice farming.

Justification

The income of rice farmers is below the minimum wage, which is 39,000 CFA francs. So how can we shed light on the working environment of those involved in rice production?

What is their level of technical efficiency in relation to production activities?

« Understanding Agricultural labour in BurkinaFaso: Looking at Gender Constraints and Satisfaction in Conventional and Ecological RiceFields»

Problématique & Objectifs

In the literature, there are two opposing schools of thought:

Agroecology is an opportunity (Gliessman, 2014)

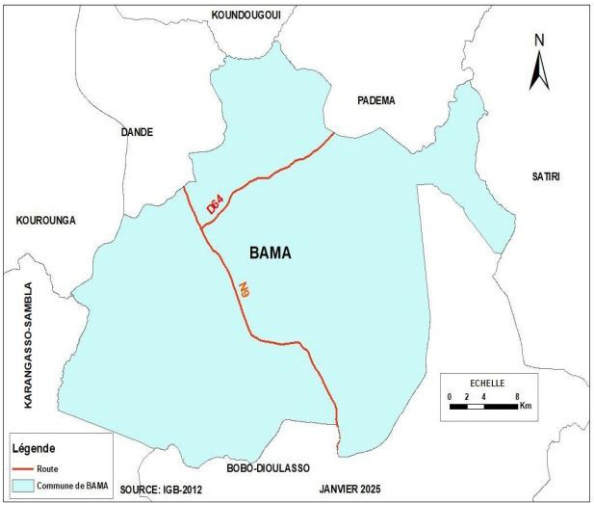
The agroecological transition is a constraint (Bezner Kerr et al., 2019).

How do the two types of agriculture compare in terms of influence, conditions, and work organization in the rice-growing areas of the Bama rice plain looking at sex desagregated data?

General objective: Analyze work organization and employment conditions on rice farms in Bama.

Analyze working conditions on agroecological and conventional rice farms.

Study areas



Bama, a rural commune located approximately 25 km northwest of Bobo-Dioulasso, in the province of Houet. It is one of the communes with high rice production potential thanks to its rice-growing plain along the Kou Valley.

Methods

- To calculate the sample size required to conduct the survey, the Slovin formula (1960) was used with a margin of error of 5%.

- $n = \frac{N}{1+N.\hat{e}}$

n = sample size; N = total population size; e = tolerated margin of error (in decimal form, e.g., 0.05 for 5%)

A random selection of 100 producers were surveyed using a questionnaire.

Six focus groups were conducted with both types of producers. Individual interviews were conducted with seven people to obtain specific clarifications.

Résultats / Choix du systèmes et facteurs de création maind'œuvre

Reasons for choosing the agroecological system

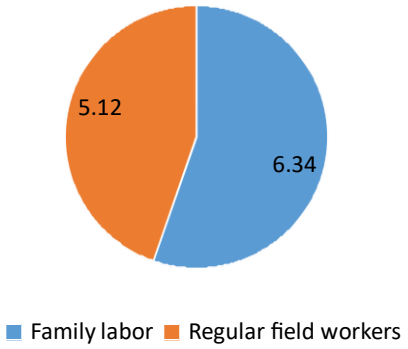
- Economic: cost reduction, increased profits
- Agronomic: sustainable improvement in soil fertility, lasting effect of organic fertilization
- Health and environmental: health protection, fewer chemicals
- Market and innovation: search for new outlets, willingness to experiment, cost efective

Raisons for choosing conventional system

- Economic: profitability, high yield, profit
- Technical/agronomic: familiar method, simpler than organic farming, readily available inputs
- Habit/experience: lack of organic training, difficult soils, low organic yields
- Market/consumption: existing demand, household consumption, stable prices

Agricultural and workers'type

Ag type	Sexe	
	Woman	Man
agroecology	2	2
conventional	21	75



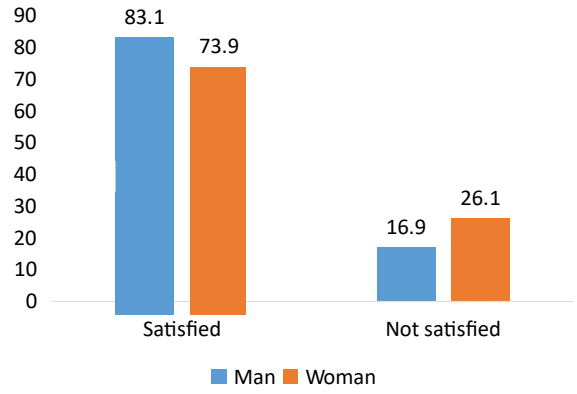
understanding of this porpotion on a random sampling at Bama show that there are very few farmers that are involve in aroecology. The main reason that was highlighted is related to the workload

who does what in terms ofacgtivities

Activities	Women	Men	
soil managment	21	75	
sowing	21	34	
weedings	20	69	
inputs	19	30	
apply pesticides	19	30	
harvesting	20	45	
threshing	20	75	
winnowing	21	00	
storage	20	69	
processing	21	45	
transport	8	75	
selling	8	75	

working conditions

❖ **Respondents satisfaction**



working conditions

It is believe that farmers often operate under difficult working conditions characterized by intense physical labor.

Working conditions in both conventional and ecological rice farms is clearly highlighted : women are in the centre of rice production in terms of temporary as well as long time work

The focus group discussions and individual interviews shed light on this.
Planting has been identified as the most difficult task in rice production for instance spacing of 25 cm/25 cm and planting one seedling per hole it requires the use of more paid labor or more time on the activity .The use of manual rotary hoes for weeding is also considered a difficult task for rice farmers. Men farmer usually hire outside labor for a daily wage or a tin of rice per day for compensation.

Hard work mainly done bywomen

Leveling: a very exhausting activity because the ground must be leveled so that water does not remain in the plot
Spreading fertilizer
Weeding before transplanting to avoid competition with weeds
Transplanting method
Replacing transplanted shoots: when shoots need to be replaced after heavy rain
Threshing: very stressful for farmer, an important phase in the production process
Monitoring the plot: the plot must be monitored constantly
Cleaning the dikes

«we are the one that cannot escape from hard work and work load. We don't have choice. usually men leave us alone for some activity....some time we do paid work because no one want to do it. So if you are looking for cash its the only way...» field data from a woman in bama 20 dec 2924

working conditions

Scoring the conditions

activity	1st most hard (%)	2nd most hard (%)	3rd most hard (%)	total score
planting	49	18	10	**193**
harvest	9	39	26	**131**
Aménagement	28	4	6	**98**
Battage	8	15	39	93
removing weeds	1	18	8	47
soil preparation	5	5	9	34

Conclusion

Leveling: a very exhausting activity because the ground must be leveled so that water does not remain in the plot

Spreading fertilizer

Weeding before transplanting to avoid competition with weeds

Transplanting method

Threshing: very stressful for the producer, an important phase in the production process

Monitoring the plot: the plot must be monitored constantly

Cleaning the dikes

Women are in the centre of rice production in terms of temporary job within the family but also outside as a labor (paid work).

The AWA Project (Agroecology in West Africa) – Agroecological food systems for sustainable agriculture and healthy diets in West Africa

Eric Vall, Ninon Sirdey

Cirad, France

In West Africa, transforming food systems based on agroecological principles is a major challenge for promoting more sustainable agriculture and healthier, more balanced diets. However, relatively few research studies succeed in integrating issues at both the production system level and the broader food system level.

In this context, the AWA project (Agroecology in West Africa) aims to develop an integrated vision and assessment of the levers and constraints of the agroecological transition, as well as the impacts of agroecological practices, in order to design coherent agroecological innovations across different levels of food systems.

The AWA project is the Southern structuring project of the Long-Term Thematic Programme "Agroecology and Food Systems (PTL2)" of the Agriculture Environment Biodiversity (AEB) Cluster of the University of Montpellier. It brings together a set of research units (SELMET, MOISA, ECO&SOLS, AIDA, INNOVATION, HORTSYST, QUALISUD) as well as Southern partners from national agricultural research systems (NARS) and universities in Senegal and Benin (University of Parakou and University of Abomey-Calavi). Research activities will be conducted in different territorial contexts and across various value chains in Senegal and Benin.

A key feature of the project is its focus on interface issues between the different components of food systems (production, collection, processing, distribution, consumption, recycling), across scales (from the farm to the territory), and across scientific disciplines. The project involves researchers from the social sciences (economics, geography), agricultural sciences (animal science, soil science, agronomy), and food sciences. This interdisciplinary and multi-dimensional approach is expected to generate insights into synergies and trade-offs between food system components, thereby supporting a coherent agroecological transition.

To this end, the project is structured mainly around four PhD theses and two postdoctoral projects, jointly supervised by at least two researchers from different units and disciplines, ensuring interdisciplinary perspectives and multi-scale analyses. At the farm practice level, one PhD focuses on the effects of agroecological practices on improving soil and crop health and their impacts on the sanitary and nutritional quality of food (PhD #3, Senegal). At the value chain level, one PhD focuses on the design of agroecological innovations with actors in the Wagashi and Amon soybean value chains based on consumer expectations (PhD #1, Benin); a second PhD focuses on the co-design of agroecological vegetable systems and the assessment of their effects on the diversity of local food supply (PhD #4, Senegal); and a postdoctoral project focuses on the co-design of biocontrol innovations for tomato blight (Alternaria) addressing food safety and public health challenges (Postdoc #1, Benin). At the level of multiple value chains, one PhD examines the effects of embedding product and co-product value chains within a territory to support agroecological transition (PhD #2, Senegal). At the national level, a postdoctoral project focuses on modelling the impact of dietary diversification on the ability of production systems (cropping systems) to respond to such changes (Postdoc #2, Senegal or Benin).

The AWA project therefore proposes an original approach by integrating actions along two complementary pathways: the first starting from upstream (production and collection) towards

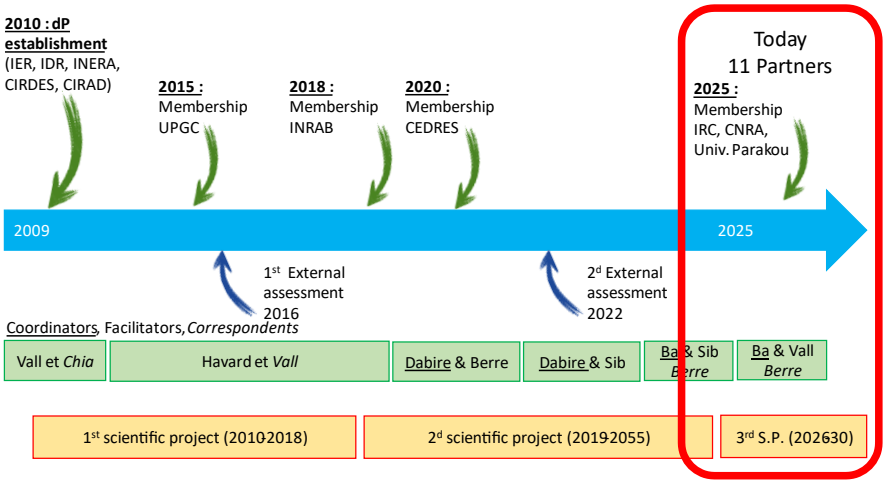
downstream food system components (processing, trade, consumption) (Postdoc #1 and PhDs #3 and #4); and the second starting from downstream food system components towards upstream production and collection (Postdoc #2 and PhDs #1 and #2).



dP ASAP
Agroecology and Agro-Sylvo-Pastoral Systems in West Africa
A 2026-2030 Scientific Project focused on production systems with the food system in mind

dP Coordinateur: Alasanne Ba (IER, baalassane_1981@yahoo.fr)
dP Facilitator: Eric Vall (Cirad, eric.vall@cirad.fr)
dP Correspondent: David Berre (Cirad, david.berre@cirad.fr)

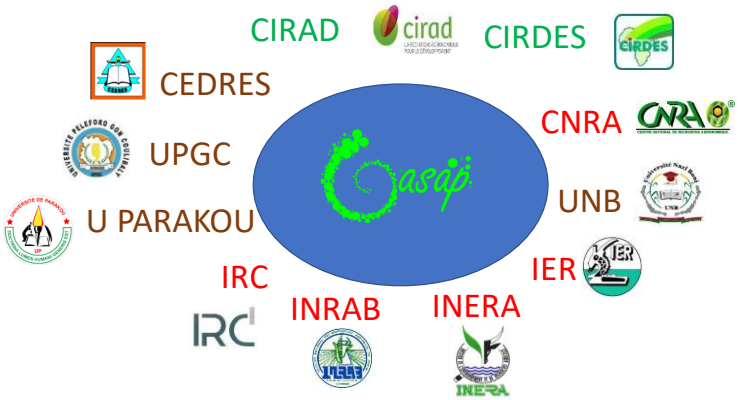
Historicalbackground



1st Science days January NN 2026

The 11 partner institutions of the PP

2 INTERNATIONAL CENTERS / 5 NARS / 4 UNIVERSITIES



~30 RESEARCHERS / ~5 PHDs Students

Challenges of the agroecological transition of agro-sylvo-pastoral systems and food systems

SWOT analysis in light of agroecological principles

Strengths
- Low input levels
- Multiple synergies
- Respect for animal welfare
- Diversified income (resilience)
- Diversified food culture
- Agropastoral social values

Weaknesses
- Poor recycling of by-products
- Severely strained soils
- Threatened cultivated biodiversity
- Lack of promotion of local products
- Poor organization of supply chains
- Contaminated food, food insecurity
- Problematic management/governance of natural resources

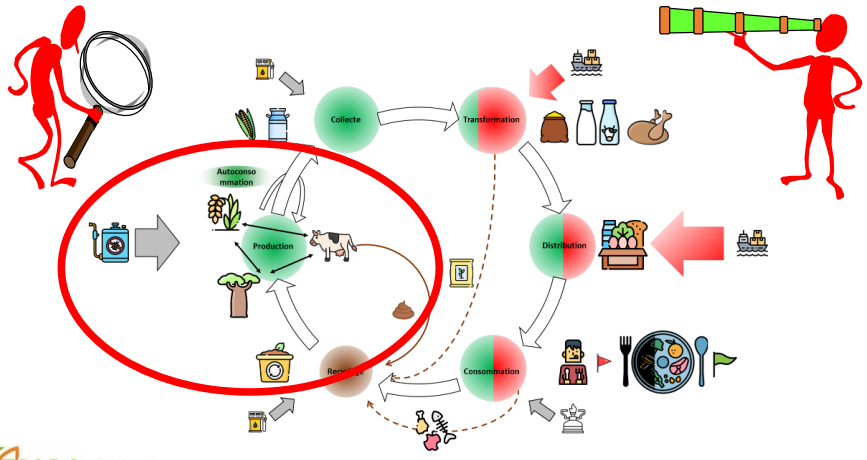
Opportunities
- Strong and increasingly demanding food consumption in terms of quality
- Favorable economic environment for agroecology
- Decision-makers and funders supportive of the agroecological transition
- Digital and AI revolution

Threats
- Biophysical threats (declining soil fertility; climate change; biodiversity loss; extreme weather; emerging diseases)
- Social tensions and insecurity
- Economic competition from imports

dP researchobject

Focused on production systems…….

……with the food system in mind



dP'sVision :generalobjective and Principles of actions

General objective:

To (co)-design agro-sylvo-pastoral systems that meet the expectations of food system stakeholders, through collaborative research that leverages agroecological principles for resilient and sustainable agriculture and greater food sovereignty

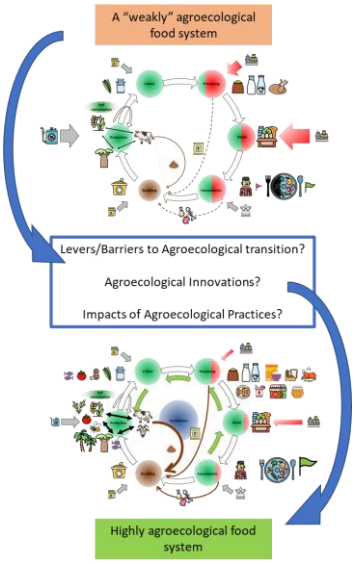
Principals of actions

- Production Link:
  - Diversification, increase, and regularity
  - Consideration of local knowledge
  - Responsible use of inputs
  - Strengthening resilience to shocks
  - Preservation of natural capital
  - Preservation of biodiversity
- Collection, processing, and distribution Links:
  - Inclusion of producers in collection;
  - Reducing imports
  - Consideration of local knowledge
  - Promotion of local products and recipes
  - Diversification of food products
  - Creation of agroecological market niches
- Consumption Link:
  - Improvement of the pillars of food security
  - Healthy and balanced diet
- Recycling Link:
  - Optimizing recycling

TSARA 1st Science days January NN 2026

Specificobjectives

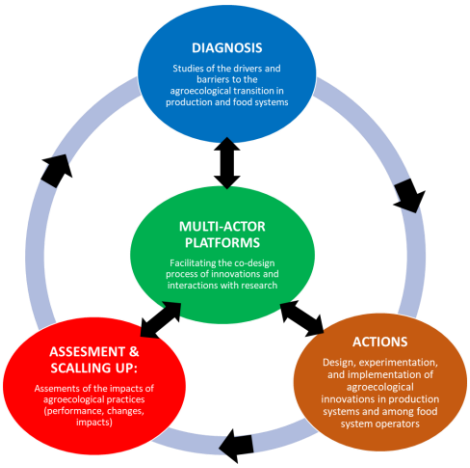
- To study the drivers and obstacles of the agroecological transition…
- To study and co-design agroecological technical and organizational innovations…
- To assess the effects of adopting agroecological innovations…



The 3 scientific components of the MAP

General approach:

Step-by-step co-design of innovations integrated into and facilitated by multi-stakeholder platforms



TSARA 1st Science days January NN 2026

Operational objectives for the next 5 years

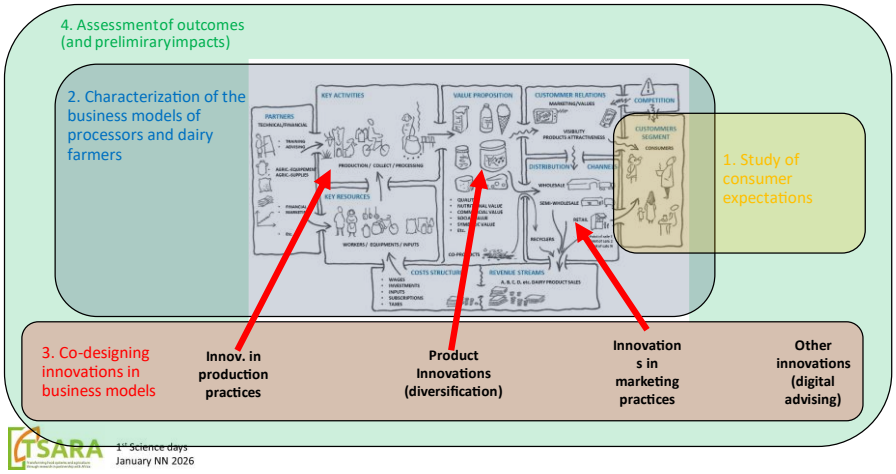
- Develop R&D projects : => 4 to 5
- PHDs : => 5
- MSc: => 10
- Training sessions : => 5
- Scientific events (conferences) : => 2
- Papers in peer -reviewed : => 10
- Policy briefs : => 3
- Technical leaflets : => 10



An example of ongoing research from component 2 of the

PHD title: Co-design of agroecological innovations in the Wagashi cheese value chain in Benin, starting from consumer expectations and operators' business models

PHD, 2026-2030, Benin, Montpellier University, Funds Pôle AEB, PTL2, AWA project



Sustainability of agro-silvopastoral practices in the Ifrane National Park (Middle Atlas, Morocco) in a context of climate change

Noé Daniel-Nguyen

Institut Agro Rennes-Angers, France

The COHUMAG project, funded by the French National Research Agency (ANR), investigates the sustainable coexistence of human activities and wildlife. It seeks to understand the causes of the conflict between farmers and the Barbary macaque (Macaca sylvanus) in the mountainous landscapes of the Middle Atlas (Morocco), where agriculture and pastoralism are the dominant activities. This interdisciplinary project involves ecologists from the ECOBIO joint research unit (University of Rennes 1) and socio-agronomists from the ESO unit (Institut Agro Rennes–Angers), in collaboration with Moroccan institutions including the Ifrane National Park (PNI) and the National Agency for Water and Forests (ANEF). The first three years of the project enabled a diagnosis of the conflict and now aim to enhance this knowledge in order to co-develop solutions for the sustainable coexistence of human activities and the Barbary macaque.

The proposed presentation for the TSARA Science Days focuses on the sustainability of agro-silvopastoral practices in the Ifrane National Park (Middle Atlas, Morocco) in the context of climate change.

The Middle Atlas is experiencing increasing drought conditions, which are profoundly destabilizing livestock systems already affected by major changes in pastoral practices, including the abandonment of transhumance and traditional community-based rangeland management systems. This has contributed to the degradation of pastoral-forest areas, driven by overgrazing and harmful practices affecting the macaque's forest habitat, such as branch cutting.

The study combines a climate analysis to assess its effects on vegetation with a qualitative survey to understand its socio-economic impacts on livestock farmers. First, climatological analyses were conducted using precipitation data from meteorological stations and satellite sources, processed with statistical methods (Mann–Kendall, Theil–Sen) to assess rainfall trends and drought dynamics. A water balance model of rangelands, based on the CropWat software, was then used to estimate the impact of precipitation variability on herbaceous vegetation.

Second, these changes in forage availability were examined within their broader socio-economic context. Semi-structured interviews were conducted with livestock farmers selected to reflect the diversity of pastoral practices. The analysis of responses enabled the identification of ideal types of forest land use. This qualitative approach sheds light on farmers' climate adaptation strategies and their impacts on the macaque's habitat.

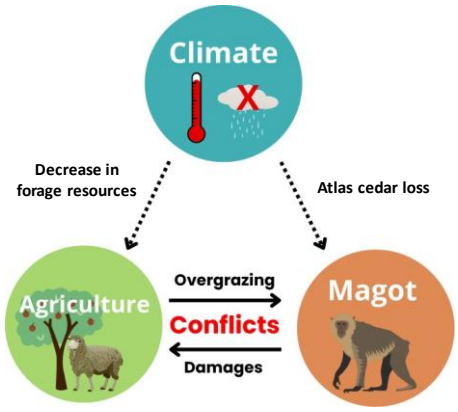
The results reveal a changing climate regime in the Ifrane National Park, characterized by spring drying trends and increasingly frequent droughts. This evolution reduces forage availability and intensifies overgrazing, thereby harming the macaque's habitat. Pressure on the ecosystem is further exacerbated by livestock sedentarization and the erosion of community-based resource governance systems. The study also highlights significant disparities in adaptive capacity among farmers, with the most vulnerable resorting more frequently to destructive practices such as branch cutting.

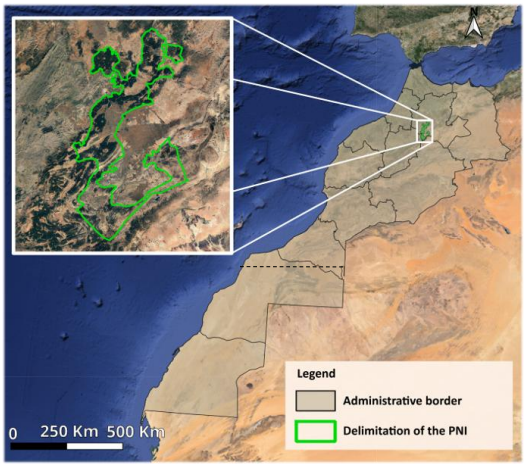
The human–macaque conflict over natural resources emerges from a dual feedback loop. On the one hand, degradation of natural resources negatively affects both human livelihoods and the park's biodiversity. On the other hand, many livestock farmers are also cherry producers, a profitable activity

whose revenues support herd expansion, thereby increasing grazing pressure. This in turn worsens habitat degradation and raises the risk of crop damage by macaques in orchards.

The search for solutions to human–macaque conflict within the COHUMAG project is therefore closely linked to the development of sustainable productive and food systems embedded in more concerted territorial development approaches. The year 2026 will focus on disseminating findings to institutional partners (PNI and ANEF) and local stakeholders, fostering science–society dialogue to co-develop solutions aimed at preserving natural spaces essential for wildlife and biodiversity. These solutions are fully aligned with broader reflections on agrarian systems and their sustainability.

Study area and context





Location of the Ifrane National Park in Morocco

Personal achievement; sources: Google Satellite & Parc National d'Ifrane (PNI) data.

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January 22 2026

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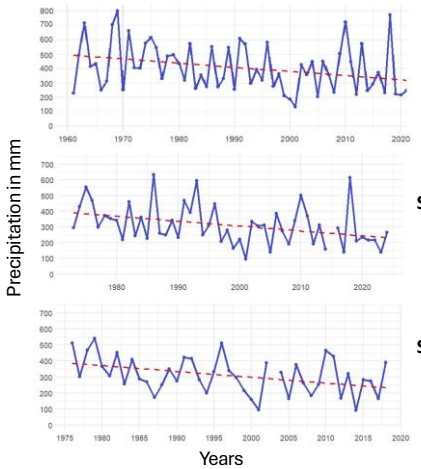
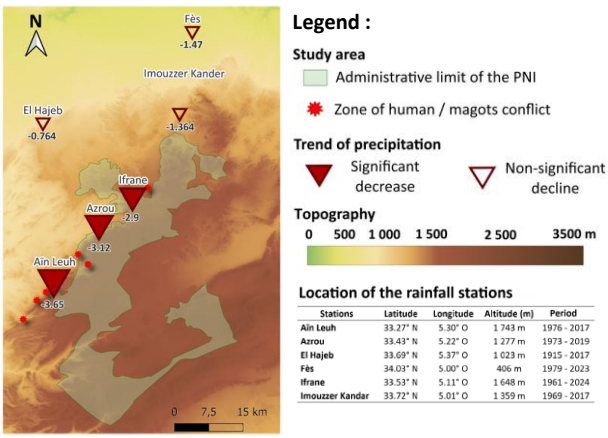
Seasonal distribution of rains

Total precipitation from February to May

Personal achievement; Source: PNI data, DGM.





Stations	Latitude	Longitude	Altitude (m)	Period
Aïn Leuh	33.27° N	5.30° O	1 743 m	1976 - 2017
Azrou	33.43° N	5.22° O	1 277 m	1973 - 2019
El Hajeb	33.69° N	5.37° O	1 023 m	1915 - 2017
Fès	34.03° N	5.00° O	406 m	1979 - 2023
Ifrane	33.53° N	5.11° O	1 648 m	1961 - 2024
Imouzzer Kandar	33.72° N	5.01° O	1 359 m	1969 - 2017

Evolution of spring precipitation (February-May) near the PNI.

Personal achievement ; sources : Direction générale de la Météorologie (DGM), SIG -Maroc, données du ParcNational d'Ifrane (PNI), Service Provincial de la Mise en Œuvre du Conseil Agricole (SPMOCA).

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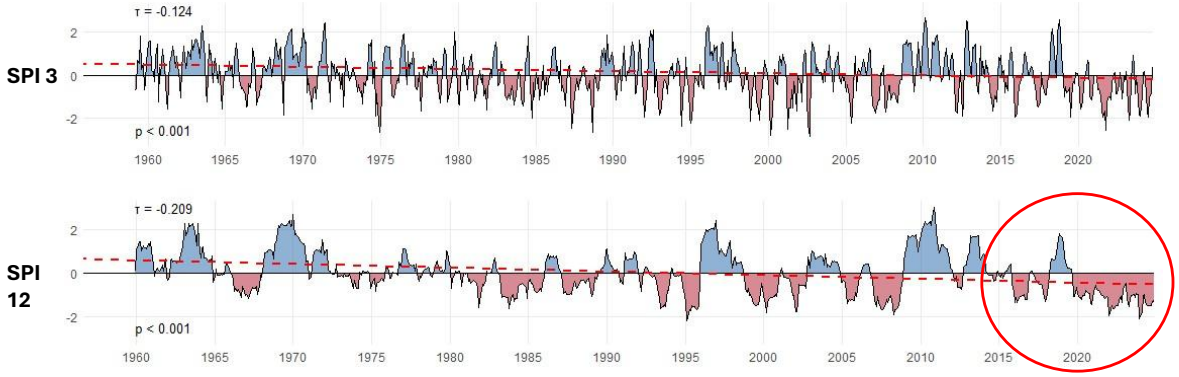
Evolution of drought episodes

Trend of SPI indices 3 and 12 at Ifrance over the period 1959-2024.

Personal achievement; Sources: Direction générale de la Météorologie (DGM), The Global Precipitation Measurement Mission (GPM)



10 years of droughts

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Adaptations of breeding practices

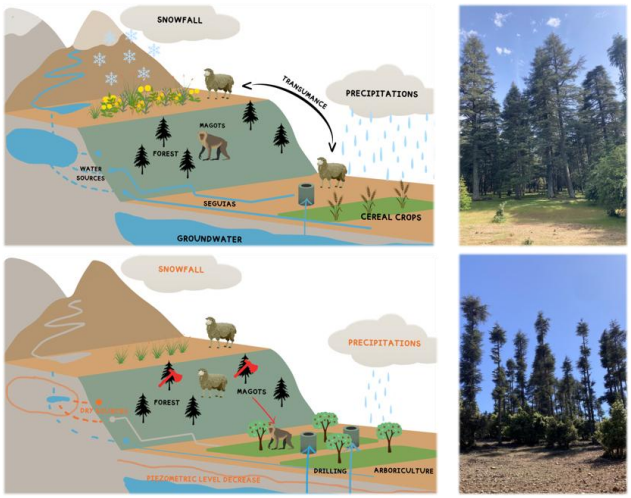
Drought Adaptation Strategies

Adaptation strategies depend on orchard ownership, fodder production capacity, and access to subsidies

- Use of external fodder
- Livestock reduction
- Pastoral mobility
- **Increased exploitation of forest resources**

Impacts on Barbary Macaque Habitat

- All forest areas are grazed.
- Increased use of tree lopping during scarcity periods.



Summary schema of climate and agricultural dynamics in Aïn Leuh

Realization Aude Jeanjean and Noé Danile-Nguyen, modification 2025.

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Documentation

- **El Alami, A., Van Lavieren, E., & Chait, A.** (2022). *The major threats to the Endangered Barbary macaque Macaca sylvanus in North Africa*. *European Journal of Ecology, 8*(2), 43–50. https://doi.org/10.17161/eurojecol.v8i2.16246
- **Minot, E., Corbeau, A., Tanvier, C., Menier, J., Silki, L., & al.** (2025). *Space use by crop-foraging Barbary macaques when crops are not available*. *Ecology and Evolution, 15*(8), e71916. https://doi.org/10.1002/ece3.71916
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Agroecological innovation pathways for food system transitions in remote agro-pastoral regions of Kunene, Namibia

Léon Bickel-Pasche

Ex-Institut Agro Montpellier, France

The Kunene region in north-western Namibia is undergoing accelerated transformations driven by climate change, changing livelihood aspirations, increasing monetisation of the economy, and evolving food consumption patterns. While Himba and Herero societies are widely recognised as livestock-keeping pastoralists, historical evidence shows that their resilience has long relied on diversified livelihood strategies, including mobility, barter systems, cross-border exchanges, and non-agricultural activities to buffer environmental and socio-economic shocks.

Since independence, growing integration into a monetary economy—combined with increased access to traded and processed foods—has initiated a gradual food system transition. However, in remote conservancies where purchasing power, market access, and transport infrastructure remain limited, households continue to depend on livestock, subsistence cropping, drought relief, and fragmented income sources. These structural constraints make external-input-based agriculture largely unfeasible, positioning agroecology as the only viable pathway for strengthening food security, autonomy, and resilience.

An agrarian diagnosis conducted in 2024 in the Ongongo and Ombujokanguindi conservancies highlights highly vulnerable agro-pastoral systems characterized by recurrent drought-induced livestock losses, declining cattle herds, increasing reliance on goats as a key safety net, weak veterinary services, declining soil fertility, crop failures linked to erratic rainfall, and rising wildlife-related losses. Food security outcomes are highly unequal: young households that have split from larger homesteads, single-mother households, widows, and families with limited labour capacity or small herds are the most exposed to food insecurity. These households face reduced access to quality grazing, limited milk production, lower cultivation capacity, and often must sell goats at low prices to purchase staple foods such as maize meal. Seasonal food gaps, delays in relief distribution, and high dependency ratios further exacerbate vulnerability.

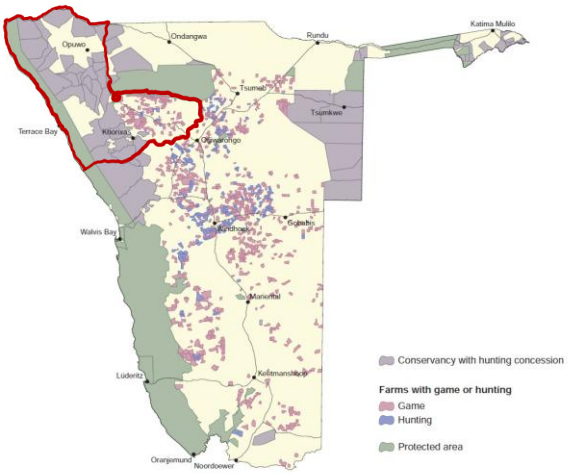
The study shows that even modest external income—such as small stipends from conservancy employment or temporary project-based activities—can significantly improve food security by enabling investment in animal health, seed acquisition, hired labour, and transport to cultivate fields in higher rainfall areas. Contrary to narratives portraying communal livestock systems as unproductive, the findings reaffirm that livestock remain the backbone of rural livelihoods, historically enabling survival through repeated climatic and socio-political shocks. However, under current conditions of market integration, reduced mobility, and increasing monetisation, livestock productivity is constrained and overall household vulnerability remains high.

The analysis identifies several locally grounded innovations with strong potential to stabilize production systems and improve food security outcomes. These include ethno-veterinary practices, community-based seed systems, collective transport and improved livestock marketing arrangements, integrated crop–livestock systems, small-scale irrigation for maize and horticulture production, and localized fodder production and processing. These innovations, rooted in Indigenous knowledge and adapted to resource constraints, represent key building blocks for agroecological intensification in arid pastoral environments. However, their diffusion, scalability, and long-term sustainability remain insufficiently understood.

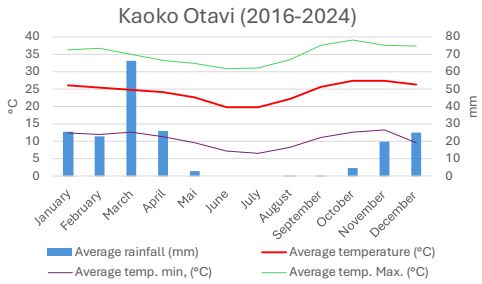
Building on these findings, the proposed PhD project aims to further investigate these innovation pathways and assess how they can enhance food security and strengthen agro-pastoral resilience in Kunene. Through interdisciplinary fieldwork and participatory approaches, the research will analyse how livestock health management, equitable market access, seed and fodder system strengthening, and irrigation-supported crop production can be adapted, scaled, and governed at the local level.

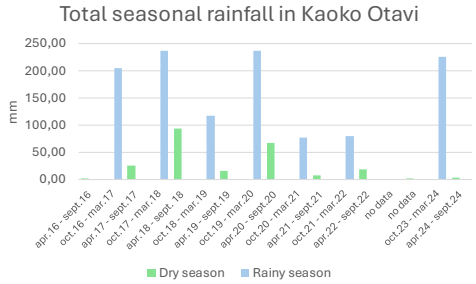


Highly variable and low rainfall context



Atlas of Namibia: its land, water and life 2022
ISBN 978-99945-53-46-4





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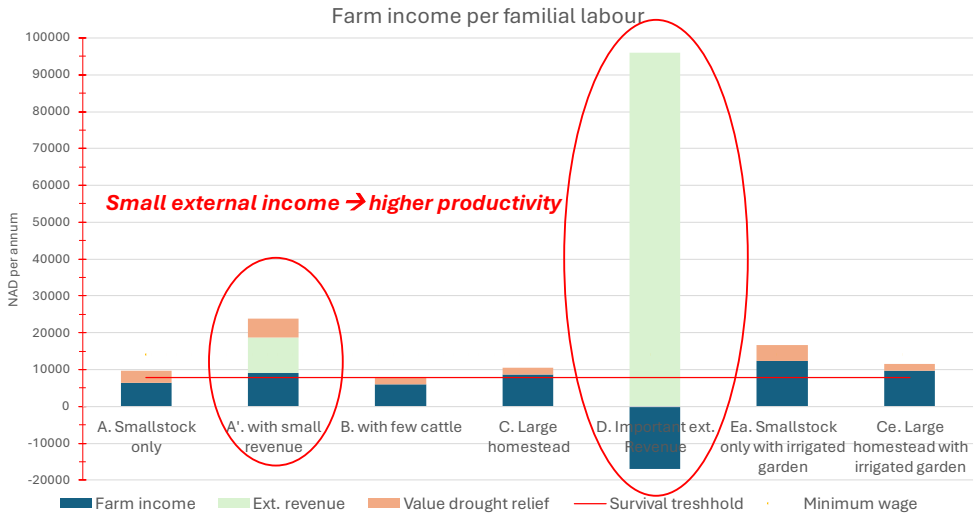

Farm income = gross value-added – material & equipments investments - wages

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Agroecological innovation pathways






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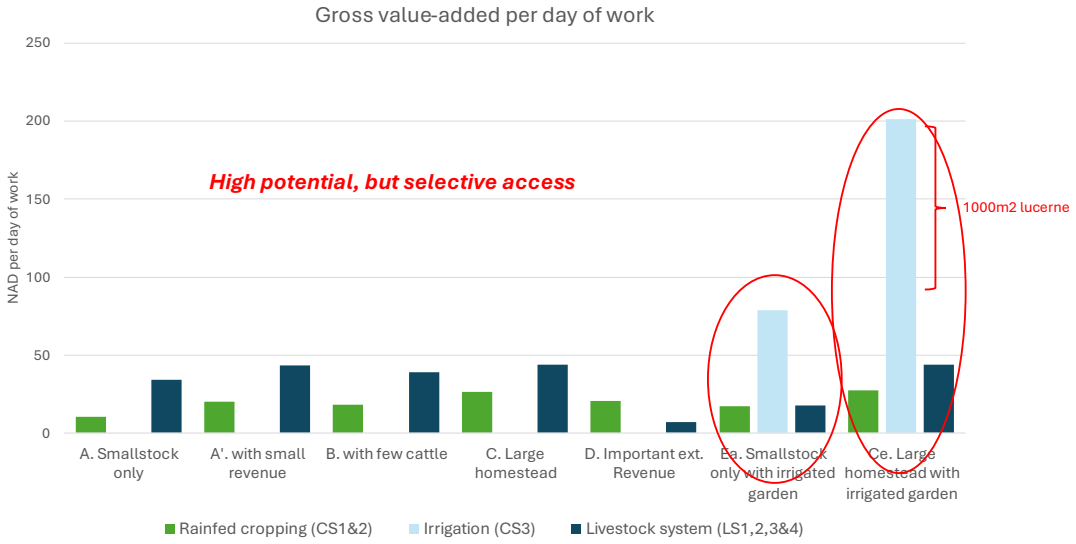

GVA = gross output (products x price)– intermediate inputs

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Pastoralism, resilience and food security: a viability-based modelling approach applied to Senegal

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In Senegal, pastoralism represents a major pillar of food security, the national economy, and rural livelihoods: nearly 30% of the population depends on it directly, and the sector contributes approximately 35% of agricultural value added. However, this system is increasingly fragile due to rising climate variability, pasture degradation, shrinking pastoral lands as agricultural expansion continues, and growing competition for land and water resources.

This study examines the conditions under which the Senegalese pastoral system can remain sustainable and resilient, while continuing to ensure food security for the population and maintain the supply of animal protein.

To address this issue, the researcher proposes a dynamic modelling framework of the Senegalese pastoral system based on viability theory. The model is composed of five state variables—vegetation biomass, herd size, pastoral mobility, pastoral household income, and consumer demand for meat—and three control variables (livestock off-take, livestock prices, and consumer population size).

Each dynamic is represented through differential equations integrating ecological processes (logistic growth of biomass and consumption through a functional response), biological processes (birth rates, mortality, and mobility costs), economic mechanisms (pastoral income, prices, and demand), and social dynamics. The model also incorporates key thematic innovations: the role of feed supplementation in stabilizing reproduction, the representation of mobility as an adaptive response to declining biomass availability, and the integration of demographic demand as a strategic driver of system dynamics.

This framework enables the derivation of viability conditions for the pastoral system and allows for the comparative assessment of the sustainability of extensive versus intensive production systems. Ultimately, it aims to inform public policy by identifying trajectories that are compatible with both pastoral resilience and national food security.

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****
DEPARTEMENT GENIE INFORMATIQUE

Viabilité alimentaire et pastoralisme au Sénégal : une approche par la théorie de la viabilité

Présenté par : Daouda NDIAYE

SPECIALITE : SYSTÈME COMPLEXE
Encadrants : Etienne DELAY,
François LAVALLÉE,
Jean Daniel CESARO,
Tuteurs : Professeur Alassane BAH

Présenté le 20 janvier 2026

PLAN

- INTRODUCTION
- METHODES ET MODELE
- RESULTATS
- CONCLUSION

INTRODUCTION



Contexte :

- Croissance de la demande mondiale en produits animaux
- Dégradation croissante des pâturages
- Le surpâturage et la dégradation des terres
- Le changement climatique

Problématique :

Comment maintenir durablement la biomasse, les troupeaux bovins, le revenu des éleveurs et la satisfaction de la demande en viande, dans un contexte de contraintes écologiques et climatiques croissantes ?



Objectif :

Comparer le système extensif et le système intensif en termes de viabilité.



METHODES ET MODELE

Théorie de la viabilité,

ViabLab,

Rstudio

Variables d'états du modèle :

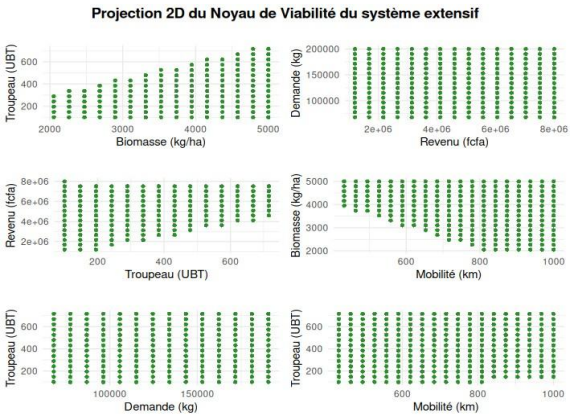
B : biomasse végétale,
N : taille du troupeau (bovins),
R : revenu des éleveurs,
D : demande en viande,
M : mobilité des troupeaux .

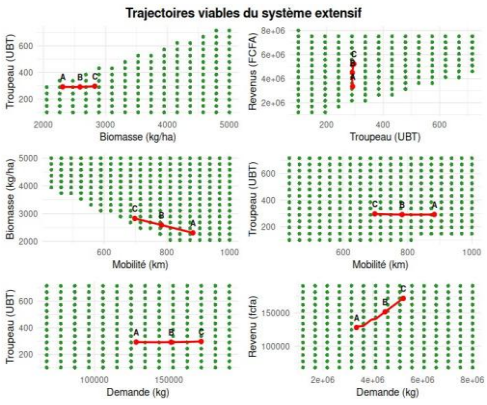
Variables de contrôles :

uA(t) : taux de prélèvement du troupeau
Pb(t) : prix du bétail
H(t) : population consommatrice

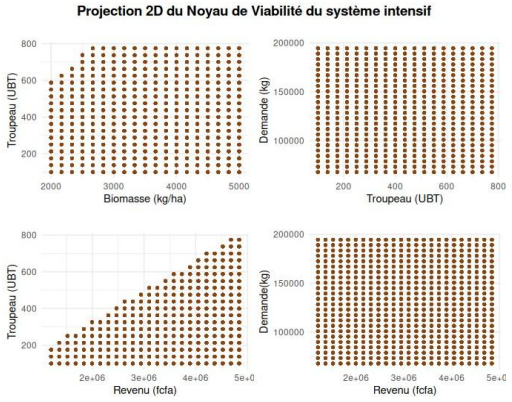
$$\frac{dB}{dt} = g_B B\left(1 - \frac{B}{K_B}\right) - \alpha N \frac{B}{B+h}(1-\kappa M) + SB,$$
$$\frac{dN}{dt} = \beta N\left(\frac{B}{B+h} + \gamma\right)(1-\lambda M) - \delta N - u_A N,$$
$$\frac{dM}{dt} = a\left(\frac{B_{\min} - B}{B_{\min}}\right) - \omega M,$$
$$\frac{dR}{dt} = P_b u_A N - c_e N - c_R R,$$
$$\frac{dD}{dt} = \mu\left(\psi H + \theta_1 Y - \theta_2 P_b - D\right) + \xi.$$

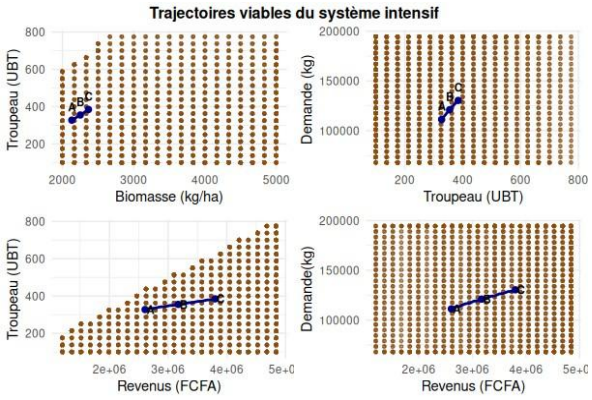
RESULTAT





RESULTAT





CONCLUSION

Le système extensif apparaît écologiquement cohérent mais fragile, tandis que le système intensif assure une meilleure sécurité alimentaire au prix d'une dépendance accrue aux intrants externes. Les résultats soulignent la nécessité de compromis entre productivité et durabilité. Des extensions futures pourraient intégrer les points d'eau, les paramètres climatiques , les système multi Agent et l' intelligence artificielle.

Territorial markets for agroecological products in Morocco between the challenge of product supply, the absence of an institutional framework, and consumer perceptions: the case of Souk Al Fellah and the Bio Shoul cooperative market in Rabat

Mohamed El Amrani

ENAM, Morocco

This research aims to understand how territorial markets for agroecological products in Rabat function in the face of challenges related to producer supply and consumer perceptions. It analyzes the organizational dynamics, the profiles of the actors involved, and the conditions for the viability of these markets.

The methodological approach is based on a systemic qualitative framework, combining the development of an appropriate analytical grid with semi-structured interviews conducted with 36 producers/processors, 58 consumers, and 12 institutional stakeholders. The study focuses on existing markets in Rabat: the Souk Al Fellah Saturday market, historically initiated by the RIAM, and the Sunday market run by the Bio Shoul cooperative.

The analysis of both markets highlights their emergence context and differentiated trajectories, as well as their fragile nature (instability, itinerant organization, lack of institutional recognition, and economic losses for producers), along with governance challenges and difficulties in meeting the expectations of informed consumers.

The study also shows that territorial agroecological markets in Rabat play an important role in the development of a local agroecological model. However, their long-term sustainability depends on institutional support, stronger internal organization, and formal recognition.

In addition, the results reveal a diversity of producer profiles across both markets (inherited farmers, neo-rural actors, career changers, activists, etc.) and varied trajectories toward agroecology, characterized by strong commitment but also shared constraints. On the consumer side, the study identifies an urban, educated, and engaged public, strongly attached to product quality and proximity with producers, but also demanding in terms of traceability, diversity, and regularity of supply.

The work concludes with several recommendations addressed to researchers, institutions, and field actors to improve the prospects of territorial markets for agroecological products.

Les marchés territoriaux des produits agroécologiques au Maroc entre le défi de l'offre des produits, l'absence d'un cadre institutionnel et les perceptions des consommateurs : Cas du Souk Al Fellah et du marché de la coopérative Bio Shoul de Rabat

EL AMRANI Mohamed et AZRHAR Fatima Zahra, ENA deMeknès

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TSARA Sciences Days
janvier 2026



Question de recherche

Comment les marchés territoriaux des produits agroécologiques au Maroc se comportent-ils face aux défis de l'offre des producteurs et aux perceptions des consommateurs ?

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Objectifs de la recherche

Le travail mené vise à :

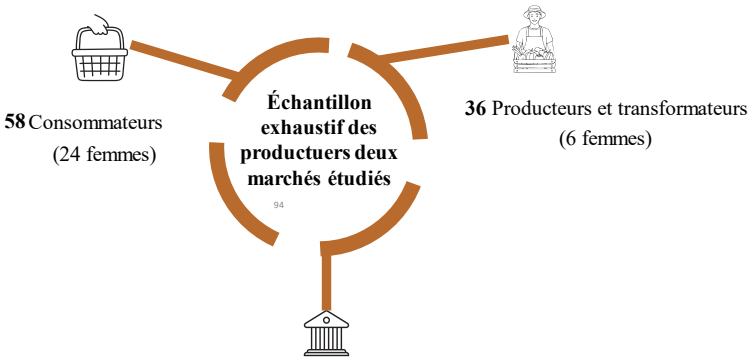
- Comprendre comment les 2 marchés territoriaux des produits agroécologiques de Rabat se comportent face aux défis liés à l'offre des producteurs et aux perceptions des consommateurs
- Analyser les conditions d'émergence, les dynamiques d'organisation, les profils des acteurs impliqués et les conditions de viabilité de ces 2 marchés.

Démarche Méthodologique

* Approche qualitative systémique

* Basée sur l'élaboration d'une grille d'analyse appropriée pour l'étude des marchés territoriaux

- Réalisation des entretiens semi-directifs
- Echantillon diversifié



Marché territorial Souk Al Fellah du Samedi



Souk Al Fellah qui a été lancé en 2017, grâce à l'initiative d'un producteur membre du RIAM et d'une consommatrice engagée. Il ne s'agissait pas d'un projet porté directement par le réseau.

Le marché réunissait **13 producteurs et transformateurs** dans la cour du **Centre Culturel Africain**. A cause de la volonté de son gestionnaire de ne plus accueillir les producteurs et de la surface restreinte partagée entre eux, ils ont quitté ce lieu.

En **2018**, le marché est accueilli par l'**IAV Hassan II**, via une convention signée avec la coopérative Fellah Bi'i – créée uniquement pour cet objectif. Mais là encore, des pressions institutionnelles et un changement de direction ont causé leur départ.

En **2019**, le marché s'installe au **Club Acacia** sans aucune convention.

En **2020**, à cause de la pandémie, la **livraison à domicile** est mise en place. Puis en **2021**, le marché reprend au Club Acacia, durant cette période, une **rupture nette avec le RIAM** s'opère : certains producteurs refusent le contrôle et verrouillent l'accès au marché par d'autres producteurs.

En **2024**, le marché est transféré à l'**Association Ribat Al Fath**, sur simple accord verbal, avec **7 producteurs seulement**, contre 13 à l'origine.

Aperçu historique sur l'émergence et évolution des 2 marchés territoriaux étudiés à Rabat

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Marché territorial du Dimanche porté par la coopérative Bio Shoul



Marché porté par la coopérative Bio Shoul, son origine remonte à 2007, à travers une première initiative de commercialisation directe dans le cadre du projet swani tika, il s'agit de paniers agroécologiques préparés collectivement par trois jeunes producteurs de la zone de Shoul avec un paiement annuel.

En **2013**, la rencontre du RIAM et l'élargissement du nombre d'adherents ont suscité une réflexion sur la création d'un **marché physique**. Et c'est en 2017, que ce marché a été lancé dans l'espace *Nature et Éveil* à Agdal, puis migre successivement en **2020** vers une villa privée à Hay Riad avec une suspension de l'activité physique à cause de la pandémie, en **2021** vers le **Club Acacia**,
et enfin en **2024** vers **l'École de Jardinage**, grâce à une convention signée avec l'établissement

Profils des producteurs des marchés territoriaux des produits agroécologiques à Rabat

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01 Producteur héritier passionné par l'agroécologie ancestrale

02 Producteurs en reconversion ou transition, souvent influencés par un tiers

03 Producteurs néo-ruraux en recherche de sens et de santé

04 Producteurs aux racines familiales agricoles, renforcés par un engagement écologique

05 Producteurs délégués insérés dans un projet agroécologique tiers

06 Producteurs militants engagés dans la structuration des dynamiques agroécologique locales

07 Autres profils engagés dans l'agroécologie et participants aux marchés territoriaux de Rabat (boulanger, vendeur de champignon et cooperatives de transformations)

Stratégies de commercialisation des produits agroécologiques adoptées par les producteurs/transformateurs des marchés territoriaux

Utilisation exclusive des marchés territoriaux

Volonté de privilégier le lien direct entre producteur et consommateur, contraintes logistiques et de main d'œuvre.

Combinaison du marché territorial et un seul circuit direct simple

Stratégie pour réduire des risques en la justifiant par une nécessité économique.

Stratégie multicanal étendue

Volonté de sécuriser le revenu et d'élargir la clientèle. Le gain économique est le principal moteur.

Profils des consommateurs des marchés territoriaux des produits agroécologiques à Rabat

Exclusivité ou mixité des achats alimentaires

- Consommateurs exclusifs (49 réponses sur 58)
- Consommateurs complémentaires mixtes (9 réponses sur 58)

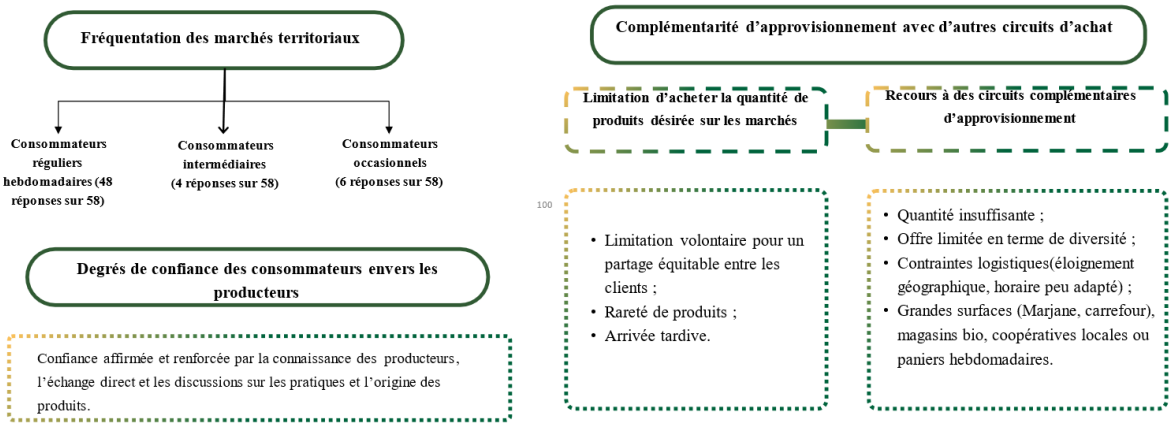
Budget hebdomadaire consacré à l'achat des produits agroécologiques

Entre 350 et 1300 DH, avec des pics de concentration autour de 400 DH (22 personnes) et 600 DH (21 personnes)

Motivation d'achat des produits agroécologiques

- Recherche de santé et de qualité alimentaire ;
- Soutien aux producteurs locaux et aux circuit courts ;
- Souci environnemental.

Comportement d'achat par les consommateurs des produits des marches territoriaux



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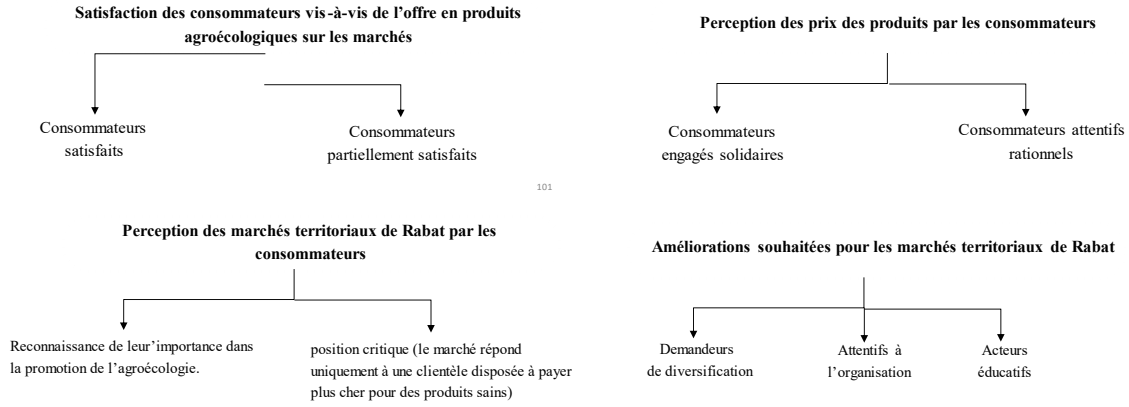
Perception de l'offre et des marchés territoriaux de Rabat par les consommateurs



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Analyse croisée des 2 marchés territoriaux des produits agroécologiques de Rabat

Obstacles majeurs à l'unification des deux marchés territoriaux

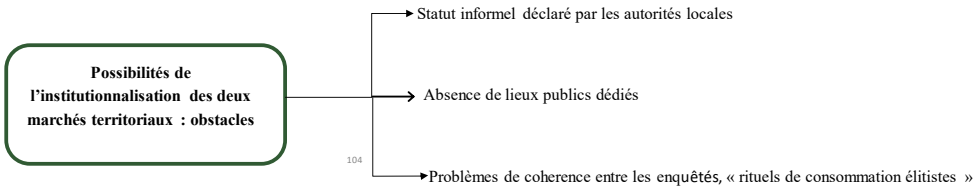
- Manque de confiance et d'harmonisation des standards
- Refus du contrôle externe et autonomie
- Concurrence interne et logiques individualistes
- Différences sociales et culturelles
- Absence de volonté politique et de cadre légal

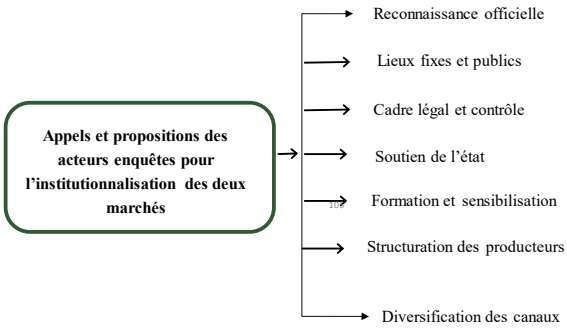
Défis des deux marchés territoriaux

- Instabilité des lieux et perte de clientèle
- Manque de reconnaissance officielle et soutien de l'État
- Viabilité économique et coûts élevés
- Perception élitiste des marchés
- Tensions internes et individualisme
- Défis climatiques et de ressources
- Manque de sensibilisation et de marketing

Opportunités offertes pour les deux marchés territoriaux des produits agroécologiques

- Demande croissante pour les produits agroécologiques
- Engagement et passion des producteurs malgré les difficultés
- Résilience des marchés
- Solidarité collective (marché du dimanche)
- Diversification des activités et canaux de vente
- Potentiel de formation et de sensibilisation des producteurs


Possibilités de l'institutionnalisation des deux marchés territoriaux : obstacles
Statut informel déclaré par les autorités locales
Absence de lieux publics dédiés
Problèmes de coherence entre les enquêtés, « rituels de consommation élitistes »


Appels et propositions des acteurs enquêtes pour l'institutionnalisation des deux marchés
Reconnaissance officielle
Lieux fixes et publics
Cadre légal et contrôle
Soutien de l'état
Formation et sensibilisation
Structuration des producteurs
Diversification des canaux

Principales Conclusions

Structuration

- Marché du samedi souffre d'une gouvernance peu impliquée ;
- Marché du dimanche est caractérisée par une structuration interne plus rigoureuse et cohérente.

Interactions entre producteurs et consommateurs

- Relations de proximité, de confiance et de l'échange ;
- Producteurs : Espace de valorisation de travail et de transmission de valeurs ;
- Consommateurs : Appréciation de relation humaine et d'échange sur les produits ;

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Évolution

- Changements de lieu ;
- Modification de la composition des producteurs ;
- Tensions internes ;
- Affaiblissement du lien initial avec les valeurs fondatrices.

Conclusions

Producteurs des marchés territoriaux

Une diversité d'origines et d'engagements forts autour de l'agroécologie.

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Consommateurs des marchés territoriaux

Des urbains instruits à la recherche de produits sains, en attente d'une offre plus diversifiée, mieux organisée, et parfois même relocalisée.

Parallel session B - Approach (modelling, monitoring, resilience)

Sustainable Food Systems in Ethiopia: Bridging Agro-ecology, Resilience, and Food Security

Bekele Akliku

Addis Ababa University, Ethiopia

Ethiopia's food systems face mounting pressure from rapid population growth, climate variability, and soil degradation, yet the country holds substantial potential for transformation through agro-ecological and sustainable food system innovations. This research examines how agro-ecological practices strengthen food system sustainability and household food security across diverse agro-ecological zones. Conducted through South–South and South–North research partnerships, the study integrates quantitative household surveys with qualitative participatory methods to assess agro-ecological performance, food system functioning, and nutrition outcomes. Findings show that although most farms currently operate at low agro-ecological performance levels, they possess considerable capacity to transition toward sustainability through differentiated pathways. Farms implementing practices such as compost-based soil fertility management, crop residue recycling, and agroforestry demonstrate significantly improved household dietary diversity and food consumption scores. Households transitioning from conventional to advanced agro-ecological farming report more diversified diets, including increased intake of vegetables, fruits, pulses, and animal-source foods, highlighting the nutritional co-benefits of agro-ecological transitions. Key determinants of sustainable food system outcomes include soil health restoration, biodiversity enhancement, and reduced dependency on external inputs. These biophysical factors interact strongly with socio-economic conditions, as access to extension services, educational level, landholding size, and market proximity influence both the adoption of sustainable practices and food security status. Spatial differences are also pronounced: midland agro-ecologies show higher prevalence of food insecurity than highland areas, underscoring the need for context-specific interventions. Overall, the research demonstrates that advancing sustainable food systems in Ethiopia requires multi-stakeholder collaboration, knowledge co-production between researchers and local communities, and policy frameworks that recognize the multi-functionality of agro-ecological systems. The results support responsible scaling of agro-ecological production alongside investments in local food systems development, institutional strengthening, and improved market linkages to accelerate transitions toward resilient and equitable food systems.

Addis Ababa University
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SEEK WISDOM, ELEVATE YOUR INTELLECT AND SERVE HUMANITY !



Sustainable Food Systems in Ethiopia:

Bridging Agroecology, Resilience, and Food Security

TSARA 1st science days

AkliluBekele(PhD), aklilu.bekele@aau.edu.et

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Background & context: Ethiopia's food system & agricultural Landscape

Deconstructing the Food System

Food systems extends far beyond just farming; it encompasses a complex web of interconnected activities from farm to plate .

1

Production

Cultivation of crops and rearing of livestock .

2

Processing & Storage

Transforming raw produce and ensuring its preservation .

3

Distribution & Markets

Getting food from producers to consumers efficiently .

4

Consumption & Nutrition

Dietary intake, food safety, and nutritional outcomes .

5

Waste Management

Minimising food loss and improving resource efficien

6

Policies & Institutions

Governance, regulations, and supportive frameworks.

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PRINCIPLES

Hallmarks of a sustainable food system

A truly sustainable food system balances productivity with critical ecological and social considerations, ensuring long term viability.

Environmentally Sound

Minimises negative impacts on ecosystems and natural resources.

Economically Viable

Provides equitable livelihoods and fair returns for producers.

Socially Inclusive

Ensures equitable access, participation, and fair practices for all.

Climate-Resilient

Adapts to and mitigates the effects of climate change.

Nutrition-Sensitive

Prioritises healthy diets and improves nutritional outcomes.

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Ethiopia's food system challenges

Climate Change & Degradation

Mounting pressures from unpredictable weather patterns and severe land degradation.

Population Growth

Increasing demographic pressures strain existing agricultural resources and production capacities.

Structural Weaknesses

Vulnerabilities in agricultural production, governance, and market systems persist.

Agroecology emerges as a transformative pathway to enhance resilience, environmental integrity, and food security.

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APPROACH

Agroecology: Farming with nature

Agroecology emphasises working in harmony with natural processes rather than against them, fostering resilient and productive ecosystems.

- **Ecological Farming Principles:** Integrates ecological science with agricultural practices.
- **Soil Conservation & Biodiversity:** Focuses on maintaining soil health and diverse ecosystems.
- **Crop–Livestock Integration:** Cycles nutrients and reduces waste through synergistic practices.
- **Indigenous Knowledge:** Values and integrates local, traditional farming wisdom.
- **Reduced Chemical Inputs:** Minimises reliance on synthetic fertilisers and pesticides.

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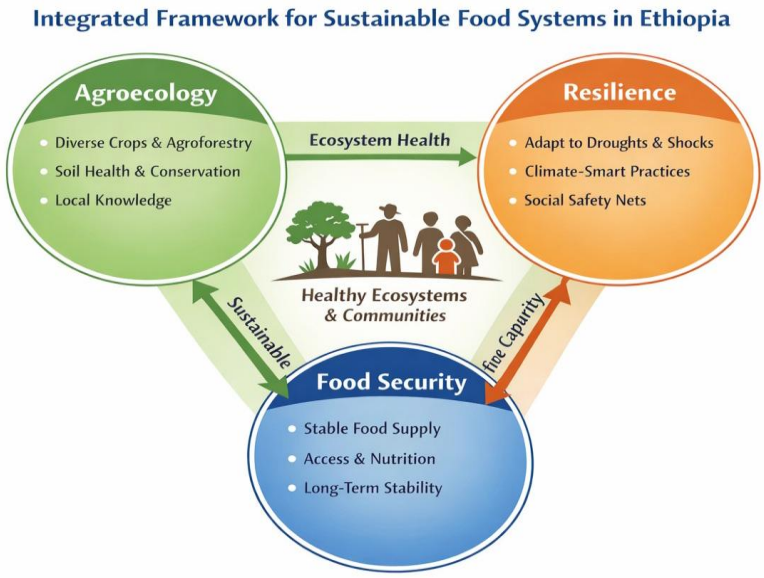

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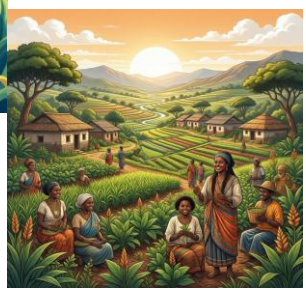
Agroecological Transition and Resilience in Ethiopia



- **Diversified Farming Systems:** Demonstrate greater tolerance to drought, pests, and climate variability compared to monoculture.
- **Soil & Water Conservation:** Enhance moisture retention, reduce erosion, and improve soil fertility.
- **Agroforestry Systems:** Improve carbon sequestration, regulate microclimates, and provide diverse products.



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CASE STUDIES

Agroecology in practice: Ethiopian examples

Ethiopian farmers are already implementing agroecological practices that improve productivity while restoring ecosystems and supporting livelihoods.



Tigray Region

Extensive use of composting, stone bunds, and terraces for soil and water conservation.



Southern Ethiopia

Traditional enset -based farming systems, known for their resilience and food security benefits.



Oromia & SW Ethiopia

Agroforestry practices, including shade-grown coffee, enhance biodiversity and soil health.

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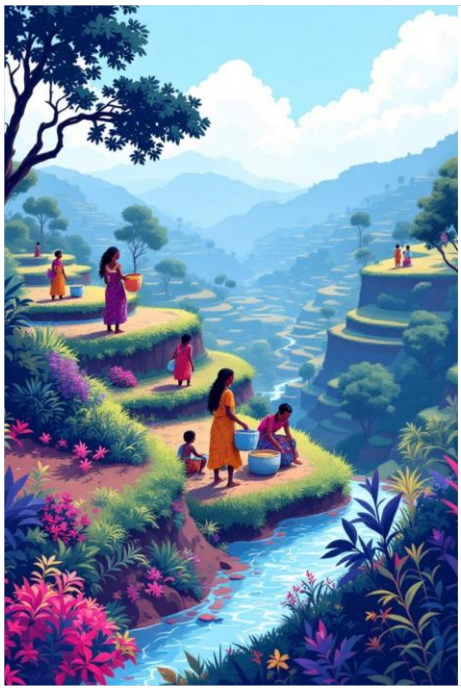

STRATEGIES

Ethiopia's Path to Resilience

Ethiopia is implementing various strategies that combine social protection with sustainable land management to strengthen food system resilience.

Productive Safety Net Programme (PSNP)

Provides food and cash transfers in exchange for participation in public works, including watershed rehabilitation.

Climate-Smart Agriculture (CSA)

Practices that sustainably increase productivity, enhance adaptation, and reduce greenhouse gas emissions.

Drought-Tolerant Crops

Promoting and distributing crop varieties specifically adapted to arid and semi -arid conditions.

Water Harvesting & Soil Management

Techniques like terracing, bunds, and small -scale irrigation to conserve water and improve soil health.

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Implications for food security and nutrition

1

Stabilised Yields

Agroecological practices contribute to more consistent crop yields, reducing vulnerability to food shortages.

2

Diversified Diets

Increased crop diversity leads to more varied and nutritious diets, especially for subsistence farmers.

3

Strengthened Local Systems

Empowering local food systems enhances community resilience and food sovereignty.

While agroecology improves local food availability, comprehensive national food security also requires robust markets, infrastructure, and social protection.

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Governance and policy challenges

Policy Incoherence

Agricultural policies often favour conventional intensification over agroecological approaches.

Limited Institutional Support

Insufficient investment in farmer-led innovation, research, and extension services for agroecology.

Market Barriers

Market structures frequently favour conventional inputs, undermining agroecological scaling.

Power Asymmetries

Smallholder voices are often marginalised within existing food system power structures.

Aligning agroecology with national food security and climate strategies requires coherent policies and long-term institutional commitment.

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Conclusion & policy implications



Integrate Strategies

Weave agroecology into national food security and climate action plans .

Strengthen Knowledge Systems

Invest in farmer-led innovation, research, and robust extension services .

Enhance Coordination

- Foster collaboration across all food system sectors and stakeholders .

Support Inclusivity

- Improve governance and market access for smallholder farmers .

Realizing agroecology's full potential requires systemic change, recognising it as both a technical and political process for long-term food security and resilience.

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Spatial modelling to advance sustainable rangeland management in Africa

Gianni Bellocchi

INRAE, VetAgro Sup, France

African rangelands exhibit strong spatio-temporal variability in vegetation structure and productivity, driven by interactions among climate, grazing pressure and plant functional traits. In the Sahel, where annual species dominate herbaceous layers and rainfall is highly unpredictable, understanding these interactions is essential for anticipating forage availability and designing agroecologically oriented grazing strategies. To address this challenge, we combined long-term field observations with process-based vegetation modelling to explore how grazing-climate interactions shape biomass dynamics in Senegalese rangelands and how these dynamics compare across contrasting African environments.The analysis draws on multi-scale datasets from Senegal - including a 16-year biomass series at Dahra Djoloff, multi-site vegetation monitoring across ecological gradients, and rainfall-exclusion experiments - complemented by observational datasets from Morocco and South Africa. These empirical data are being used to evaluate and adapt the ModVege-CoSMo model for African rangelands. Model developments focus on three scientific gaps identified across regions: (i) the need for explicit representation of heterogeneous grazing behaviour arising from selective foraging and herd mobility; (ii) improved phenological rules for short-lived annual species, for which temperature-based growth cessation is insufficient; and (iii) the integration of tree-grass interactions, which influence understory microclimate and spatial patterns of regrowth. Field missions in 2024 across Senegal (Dahra, Widou Thiengoly, Niakhar) provided direct observations of patch-level grazing processes, confirming that spatial heterogeneity in defoliation contributes to the persistence of reproductive structures and late-season forage under variable rainfall. Preliminary simulations using the spatialized model reproduce these emergent patterns more realistically than homogeneous grazing rules, particularly under moderate grazing intensities. Cross-regional comparisons, supported by dataset harmonization across Morocco and South Africa, reinforce the importance of representing annual-dominated vegetation and woody cover to capture system-specific resilience mechanisms. Ongoing ecophysiological characterization of key African species in semi-controlled conditions will further refine parameterization, enabling more rigorous cross-site evaluation. Overall, this work demonstrates that combining long-term datasets with spatially explicit modelling improves mechanistic understanding of vegetation responses to grazing and climate variability in African rangelands. These insights provide a scientific basis for evaluating agroecological grazing strategies, anticipating forage shortfalls, and assessing the resilience of pastoral food systems under changing environmental conditions.

Conclusion & policy implications



Integrate Strategies

Weave agroecology into national food security and climate action plans .

Strengthen Knowledge Systems

Invest in farmer -led innovation, research, and robust extension services .

- Enhance Coordination
- Foster collaboration across all food system sectors and stakeholders .

- Support Inclusivity
- Improve governance and market access for smallholder farmers .

Realizing agroecology's full potential requires systemic change, recognising it as both a technical and political process for long-term food security and resilience.

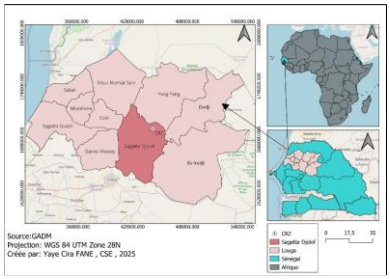
Made with GAMMA

Structural limitations of temperate grassland models revealed in Sahelian rangelands

Yaye Cira Fane et al.



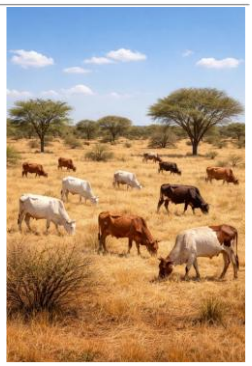
Protected plot (D)	Abundance (%)	Grazed plot (P)	Abundance (%)	
Fabaceae	46.5	*Rubiaceae*	52.1	+42%
Poaceae	30.2	*Fabaceae*	29.5	-17%
Rubiaceae	10.1	*Poaceae*	15.2	-15%
Convolvulaceae	8.3	*Convolvulaceae*	3.0	
Zygophyllaceae	4.9	*Amaranthaceae*	0.4	

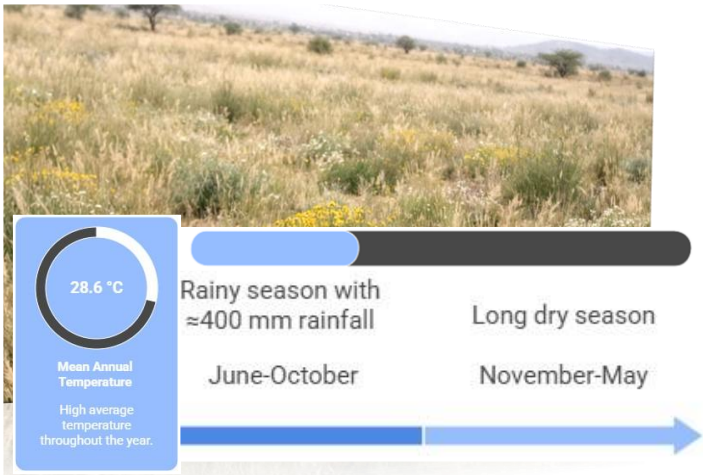




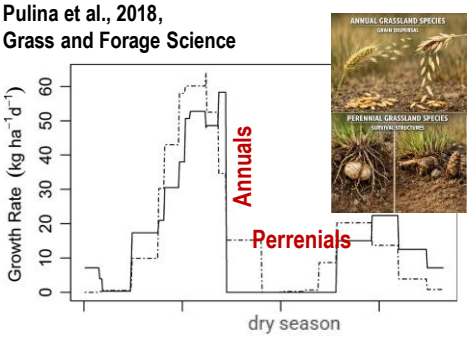
Woody species:
- *Balanites aegyptiaca* (Z)
- *Vachellia tortilis* (F)
- *Boscia senegalensis* (C)

Annual herbaceous species:
- *Cenchrus biflorus* (P)
- *Schoenefeldia gracilis* (P)
- *Dactyloctenium aegyptium* (P)
- *Aristida mutabilis* (P)
- *Zornia glochidiata* (F)

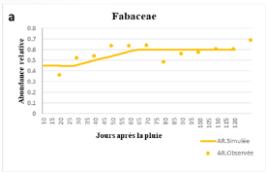


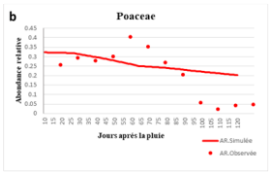


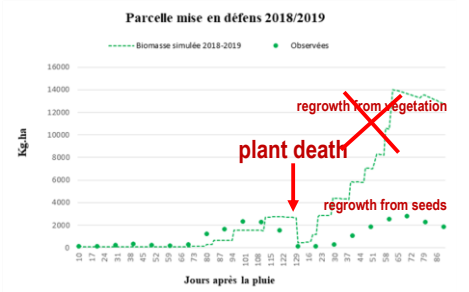
Pulina et al., 2018, Grass and Forage Science



Seasonal fluctuations (dominant family) vs. overall trends







CIHEAM IAM MONTPELLIER — PAUL VALÉRY MONTPELLIER

MASTER 2
GESTION DES TERRITOIRES ET DEVELOPPEMENT LOCAL
PARCOURS « CHANGEMENT CLIMATIQUE, GESTION AGRICOLE ET TERRITOIRES »

Mémoire présenté par : **SAMIRI Oulaya**

Adaptation du modèle ModVege aux prairies annuelles : un outil d'aide à la décision pour la gestion des pâturages face à la variabilité climatique

Sous la direction de : **TRISTAN Berchoux, HARBOUZE Rachid**
Maître de stage : **MARTIN Raphael,**
Porteur de projet : **BELLOCCHI Gianni**

Septembre 2025

$$GRO = PGRO * ENV * SEA$$ ← *reservestorageandmobilisation*

In the favourable season → the plant photosynthesises a lot → stores reserves in the underground organs (roots, bulbs, rhizomes, collars).



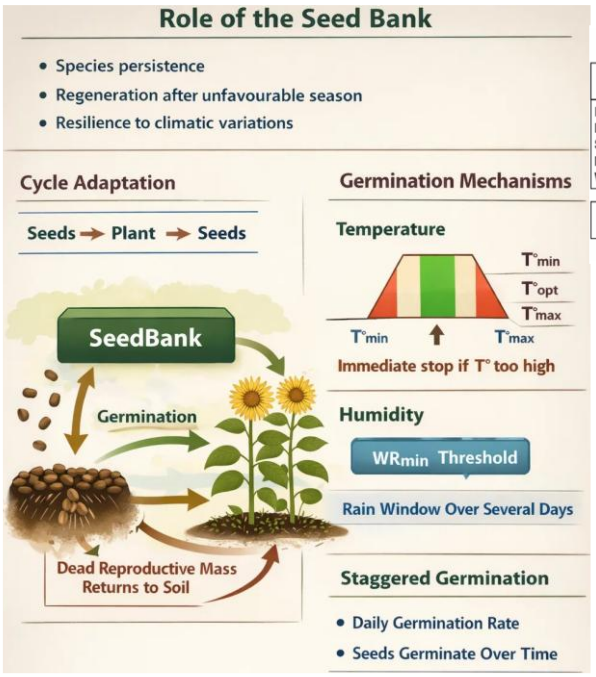


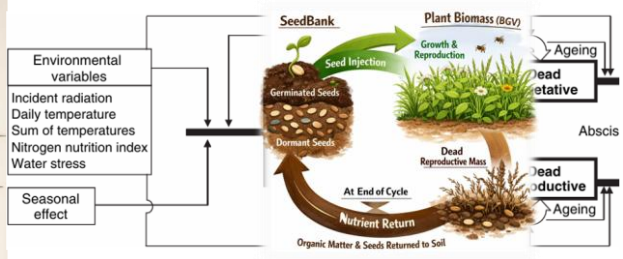
In the unfavourable season → the plant mobilises these reserves → restarts growth as soon as water returns, even with few leaves to start with.

SEA = 1

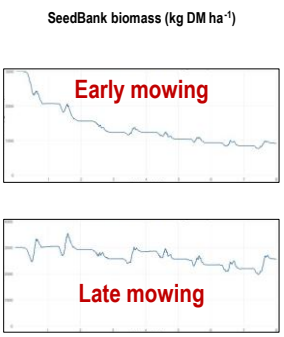
$$GRO = PGRO * ENV * \mathbf{SeedBank}$$











Chambres d'agriculture des Hauts-de-France (2025)



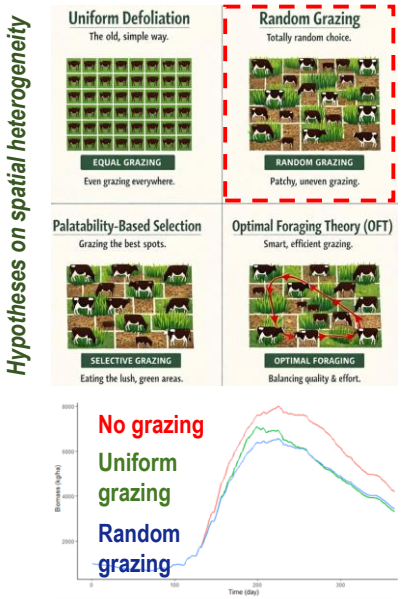
The SeedBank dynamics in ModVege adapted to annuals can be used to link ecology and management by simulating the effect of agricultural practices on the persistence of annual species and the resilience of the forage system.

Current limitations:

- Simplified economic analysis
- Generic parameters (need for empirical validation)
- Animal grazing not yet taken into account (only mowing)

Enhancing grassland simulations by evaluating grazing representations in ModVege

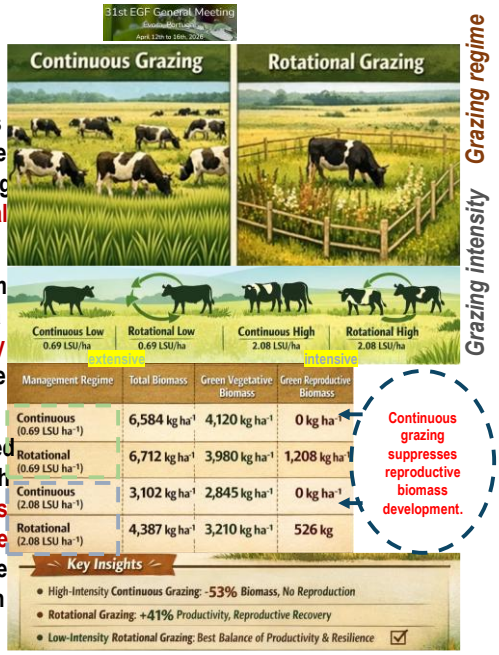
Masson M. et al.



The random method is the simplest viable option for generating realistic spatial heterogeneity

Animals in random grazing feed from only a few cells, causing heavy defoliation in those spots

This concentrated pressure limits regrowth and ultimately reduces overall pasture productivity and average biomass compared with more uniform grazing





Integrated modelling and digital technology to strengthen the resilience of silvo-pastoral systems to CC

ongoing

cirad

Multi-scale modelling for the sustainable management of pastoral ecosystems: integration of remote sensing, ecophysiology and management scenarios in Sahelian contexts

submitted



ongoing

2025 Doctoral Research

UNISA

African Pastures and Modelling for a Sustainable rangeland ecosystem in Africa:

Modelling the evolution of endemic grass species in rangelands using different climatic and management variables

?

2RI Réseau de recherche international

Genetic diversity of Cameroon Indigenous Pigs and agroecological resilience

Pierre Faux

INRAE, France

Paul Fewou Moundipa

Yaoundé 1, Cameroon

Olivia Ghomsi

IRAD, Cameroon

As in other sub-Saharan African countries, indigenous pig breeds in Cameroon constitute a key component of traditional agricultural systems. These animals fulfil multiple functions, the main one being the production of affordable local meat adapted to its environment (notably due to better digestibility and higher resistance to local pathogens compared to commercial breeds). Moreover, given the sustained growth in demand for pork observed in Cameroon over the past decade, these local pig breeds represent a major asset for ensuring national food sovereignty while promoting livestock systems with positive societal characteristics.

However, these local breeds remain relatively poorly documented. Although recent research has (1) phenotypically characterized these animals, (2) demonstrated their adaptation to local environments, and (3) shown that they can reach productive levels comparable to commercial breeds, their genetic dimension has not yet been explored. In this context, we initiated in 2025 the TSARA CAMPIGEN project, whose main objective is to perform a detailed genetic characterization of a representative sample of the genetic diversity of the species within traditional agro-systems in Cameroon.

Several scientific questions underpin this objective. First, what are the relationships between these breeds, and how are they structured spatially? Second, to what extent are individuals genetically similar within each breed? And third, is there evidence of significant admixture with globally distributed commercial breeds?

To address these questions, we assembled a dataset of 240 indigenous pigs and 48 pigs from the main commercial breeds used in the country. We then propose to genotype all individuals using a high-density SNP chip and to conduct population genetics analyses on the resulting data. Preliminary results based on 164 genotyped indigenous pigs reveal a marked genetic differentiation between two agro-ecological zones of Cameroon (the Sudano-Sahelian zone and the Western highlands). Pigs from the humid forest zone with bimodal rainfall do not form a distinct genetic group, a finding consistent with the observation that these pigs are frequently introduced through internal migration from the Sudano-Sahelian regions.

Through this work, we demonstrate that genetic characterization is a key lever both for the conservation of indigenous breeds and for their sustainable use within traditional livestock systems. It is particularly relevant for supporting the development of local value chains based on agroecological and resilient food and livestock systems.

Genetic diversity of Cameroon Indigenous Pigs and agroecological resilience

Olivia GHOMSI[1], Paul MOUNDIPA[2] and Pierre FAUX[3]

[1]Division des productions animales et halieutiques, IRAD Nkolbisson (Cameroun)
[2]Département de Biochimie, Université de Yaoundé I (Cameroun)
[3]UMR GenPhySE, INRAE Occitanie-Toulouse (France)

1st TSARA Science Days – January 20th 2026

Agroecological relevance of Cameroon Indigenous Pigs (CIP)

- **Local** breeds from Cameroon
  - **Low admixture** expected with exotic breeds
  - Good **adaptation** (e.g. heat and pathogen resistance)
  - Various **advantages** (growth, organoleptic quality)
- Used in **traditional farming systems**
  - **Various roles**: social, economic, ecological
  - **Low-input** systems



(from Ghomsi *et al.*, 2018)

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- **Conservation** issues
  - Competition with **exotic breeds**
  - Unknown **diversity**

- … but has **great potential**
  - To face **raising meat demand**
  - To **understand origins of African pigs**

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+ Highlighting the **genetic specificity of CIP** should **empower local communities**

The CAMPIGEN project: main goals

"CAMeroon PIGs Genetics"

- Genetic characterization of **Cameroon Indigenous Pigs**
  - Sampled in **3 agroecological zones** of Cameroon

To help promote the **local pig's use and conservation**

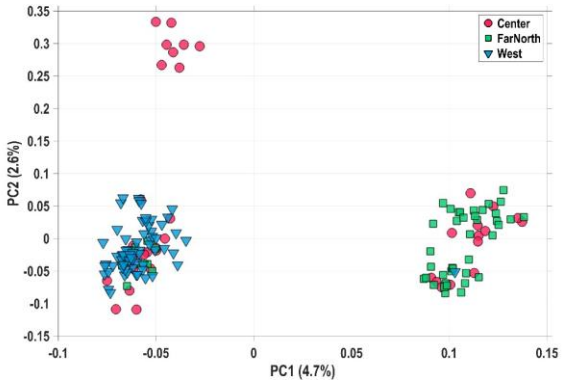
To understand their **origins**, the level of **admixture with non-African pigs** and their genetic **diversity**

- Scientific exchanges and **knowledge transfer**
  - 3-months **scientific stay** for a Cameroonian researcher at INRAE Toulouse
  - 1-week **bioinformatics and popgen class** at IRAD Nkolbisson

Project's current advance

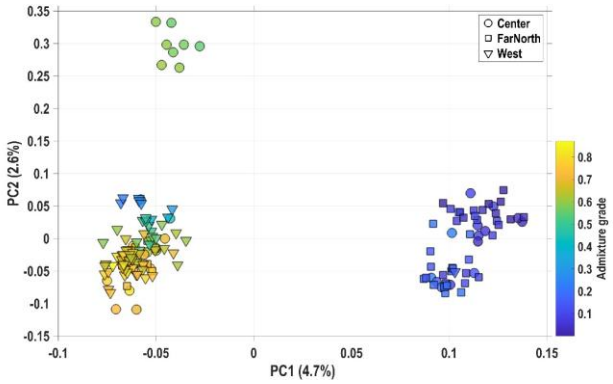
- **Scientific stay** of Dr. Olivia GHOMSI at GenPhySE lab (INRAE Occitanie Toulouse)
  - Learning in molecular genetics, bioinformatics and population genetics
  - Contribution to genetic analyses
- **Genotyping** of a 1st batch of 164 CIP
  - Collected, phenotyped and extracted within Dr. GHOMSI's doctoral thesis
  - Using the **pig HD chip** (507k autosomal SNPs after filters)
  - Removal of likely duplicates → **155 samples** left
- Assessment of **genetic structure** and admixture with pigs from the Northern hemisphere

Genetic structure and admixture patterns



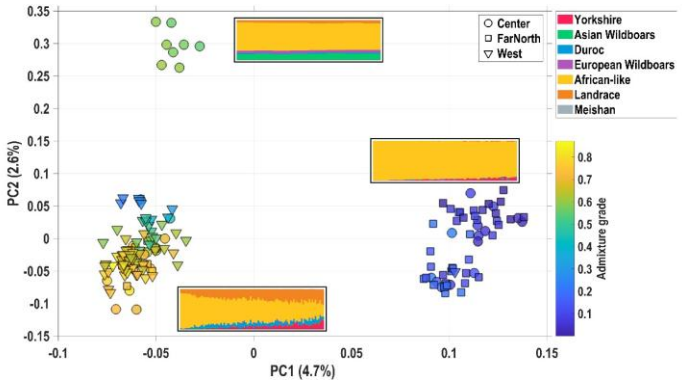
- Structure seems **geographic at first glance**

Genetic structure and admixture patterns



- Structure seems **geographic at first glance**
- But is actually driven by **admixture**

Genetic structure and admixture patterns



- Structure seems **geographic at first glance**
- But is actually driven by **admixture**
- Pigs with "African-like" background **mostly found in the Far North**

Conclusions and future work

Take-home messages

- Genetic characterization is a **key element** in agroecology development
- Highlighting a putative **African genetic background**

Coming soon

- Genotyping of **96 additional samples**
  - Including 48 **exotic** pigs
- Whole-genome **sequencing** of 6 samples
  - More accurate details on **gene flow** and its **timing**
- **Results communication** (conference, article)
- Assessment of **diversity** in CIP

Acknowledgements

- Olivia GHOMSI (IRAD Nkolbisson)
- Paul MOUNDIPA (Univ. Yaoundé I)
- The TSARA Initiative

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- Université de Maroua (Cameroun)
  - Courage WIRNKAR

- UMR GenPhySE (France)
  - Nathalie IANNUCCELLI
  - Julie DEMARS
  - Bertrand SERVIN
  - Magali BLANIÉ

Bridging agroecology and food systems: Scaling potential of multistakeholder fodder innovation in the Senegal River Delta

Ferrari Serena

CIRAD - UMR Selmet, Ethiopia

Thiandoum Astou

Institut Agro Montpellier, France

Sy Fatoumata

Institut Agro Montpellier, France

This study explores the scaling potential of a multi-stakeholder innovation initiated in the Dagana department of Senegal, aimed at resolving the critical shortage of livestock feed during the dry season while mitigating historical land-use conflicts. The innovation involves the cultivation of cowpea (niébé) fodder on the fallow lands of the Compagnie Sucrière Sénégalaise (CSS) in collaboration with the Plateforme Innovation Lait (PIL), research institutes (CIRAD, ISRA), and local herder cooperatives. At the heart of the initiative is the commitment to contribute to the sustainable development of livestock farming and milk production, while simultaneously improving the quality of cultivated soils and promoting peaceful cohabitation between stakeholders in the territory. By analyzing the initiative through technical, organizational, and socio-cultural dimensions, the study assesses how this pilot project creates a pathway for sustainable coexistence between industrial agribusiness and family pastoralism.

The research highlights that the innovation possesses strong potential for scaling (out, up, and deep). It builds on the scaling framework, consisting in three main types of scaling in innovation development (Robin & Lesenfants, 2024), that are scaling out (spreading adoption), scaling up (institutional and policy changes), and scaling deep (cultural and behavioral shifts). Technically, the model has successfully scaled to 250 hectares by integrating a leguminous crop into sugarcane rotations, utilizing a low-input itinerary that is both mechanically efficient for the industry and replicable by local agro-pastoralists (scaling out). Organizationally, the innovation relies on a multi-actor governance framework that facilitates dialogue, price setting, and logistical coordination, marking a departure from informal, conflict-prone interactions to formalized, service-oriented relationships, (scaling up), though the study notes the necessity of formalizing these agreements to ensure longevity. Socio-culturally, the project drives a profound shift in territorial dynamics, moving stakeholders from resource competition to a cooperative "win-win" relationship, and encouraging the emergence of a new class of "agro-fodder" producers among traditional herders (scaling deep).

This innovation establishes a critical link between the principles of agroecology, the functioning of food systems, and their outcomes. By introducing nitrogen-fixing cowpea into monoculture rotations, the project directly enhances soil health and biodiversity while achieving significant input reduction (agroecology). These ecological improvements reshape the functioning of the food system by optimizing production cycles on fallow lands, reducing losses associated with livestock malnutrition, and creating a structured value chain that connects industrial resources with local herder needs. Consequently, these shifts generate robust outcomes: they ensure environmental sustainability through land regeneration, promote socio-economic sustainability by pacifying territorial conflicts and lowering production costs for herders, and directly improve food security, nutrition, and health by stabilizing milk yields during the lean season.

Ultimately, the study concludes that while the technical and social foundations for scaling are present, the full scaling up of this innovation requires institutional support and public policy integration. Recognizing this model at a national level could transform it from a local corporate social responsibility initiative into a systemic solution for pastoral resilience in the Sahel.

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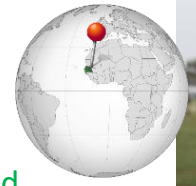
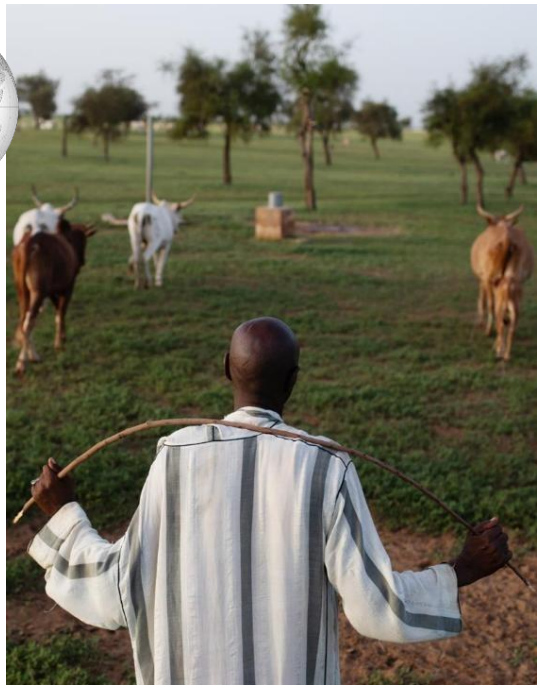
AGRICULTURAL RESEARCH FOR DEVELOPMENT



Bridging agroecology and food systems

Scaling potential of multistakeholder fodder **innovation** in the Senegal River Delta

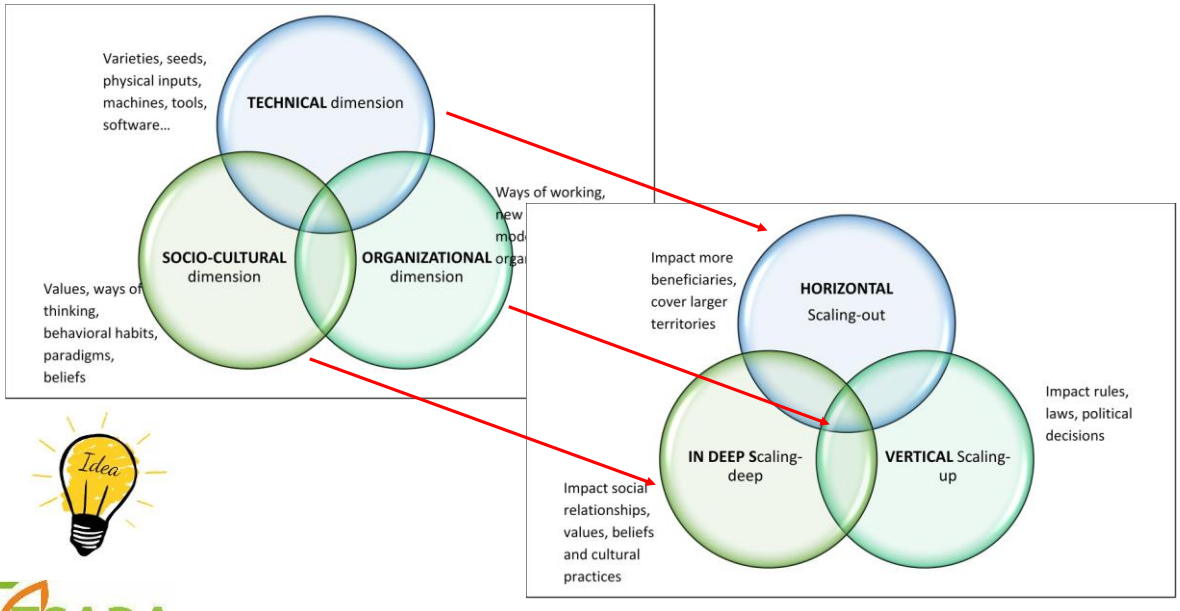


Serena Ferrari, Astou Thiandoum, Fatoumata Sy

TSARA
Transforming food systems and agriculture through research in partnership with Africa

3rd Science days
January 20, 2026

FERRARI Serena
Scaling fodder innovations



TSARA
Transforming food systems and agriculture through research in partnership with Africa

3rd Science days
January 20, 2026

FERRARI Serena
Scaling fodder innovations

serena.ferrari@cirad.fr

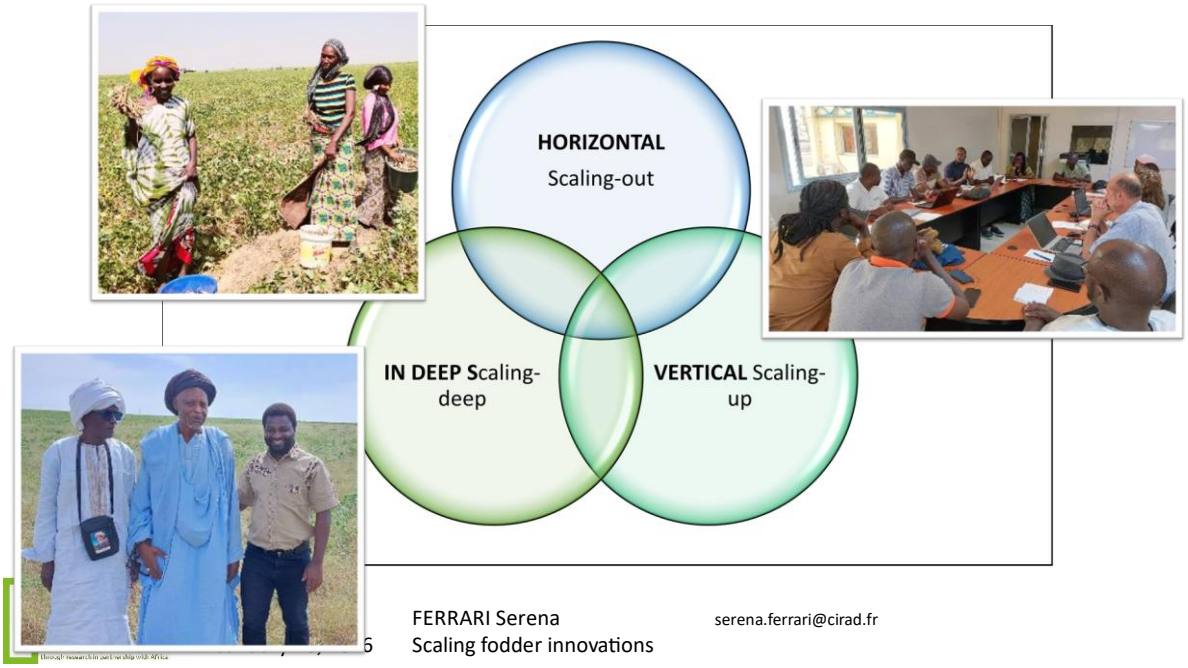
Innovation

Fodder crops on the fallow lands of sugarcane agribusiness in partnership with pastoralists

Objectives

1. Improve the quality of cultivated soils
2. Contribute to the sustainable development of pastoralism and dairy production
3. Promote cooperation and peaceful coexistence among stakeholders in the region





Phage biocontrol for the emerging bacterial leaf blight epidemic in Madagascar

Clara Torres-Barceló

PHIM, France

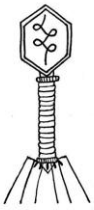
Rice production in Africa faces increasing challenges from emerging and rapidly evolving plant pathogens. Among them, Xanthomonas oryzae pv. oryzae (Xoo), the causal agent of bacterial leaf blight (BLB), remains one of the most damaging diseases threatening rice cultivation. Recently detected in Madagascar, BLB can cause yield losses of up to 50% and thus jeopardises food security in regions already exposed to climatic and economic instability. Conventional management strategies rely largely on resistant rice varieties, but these are often rapidly overcome by dynamic pathogen populations. In this context, bacteriophages (phages)—viruses that infect bacteria—are gaining attention as sustainable, low-input alternatives for crop protection.

This work forms part of DIAGNET (Diagnostic des maladies du riz en Afrique Subsaharienne), a TSARA-funded programme aimed at strengthening diagnostic tools, epidemiological surveillance, and innovative biocontrol methods for rice diseases in Africa. A key objective of our contribution within DIAGNET is to develop a phage-based biocontrol strategy applicable directly to rice seeds, a major potential route of Xoo dissemination. To support this goal, we conducted a large-scale field sampling campaign across three rice-growing regions of Madagascar in February 2025. Ninety samples (soil, water, and symptomatic leaves) yielded 51 Xoo isolates and 81 lytic phages, with phage activity detected in 85% of samples. Forty-six phages have been sequenced using Nanopore long-read technology, providing the first genomic overview of Xoo phages in Africa.

Importantly, this genomic and ecological characterisation is not merely descriptive: it allows the selection of robust, complementary phages for a seed-treatment biocontrol cocktail. Understanding phage diversity, host range, and ecological structure across fields and localities will enable us to identify phages with the greatest potential for suppressing diverse Xoo populations during early plant development.

Beyond scientific advances, this work represents a highly productive and enriching collaborative effort. The Madagascar team organised the sampling campaign and trained the France-based scientists in recognising BLB symptoms. A Malagasy Master's student, co-supervised by both teams, received hands-on training in phage isolation and characterisation, which enabled him to independently produce and analyse 13 additional phages and to develop the foundations of a future PhD project. Training seminars delivered at FOFIFA have further strengthened local expertise, and the planned transfer of an 80-phage collection will establish Madagascar's first national phage resource bank.

Phage biocontrol for the emerging bacterial leaf blight epidemic in Madagascar





TORRES-BARCELÓ Clara
Phage biocontrol rice
clara.torresbarcelo@inrae.fr

Rice bacterial leaf blight (BLB)

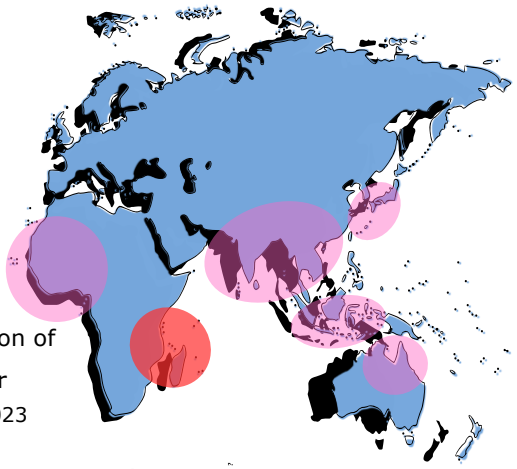
Caused by :
Xanthomonas oryzae pv. *oryzae* (*Xoo*)





2019 : First identification of BLB in Madagascar
H. Raveloson *et al.*, 2023

Xoo repartition according to EPPO, 2024



1st Science days
January 20 2026

TORRES-BARCELÓ Clara
Phage biocontrol rice
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Field work :

Harinjaka RAVELOSON
Ravo RABEKIJANA
Natolotra RAKOTONANAHARY
Judicael ANJARAFANOMEZANA
Mathilde HUTIN
Sarah DELAFOSSE
Clara TORRES-BARCELÓ

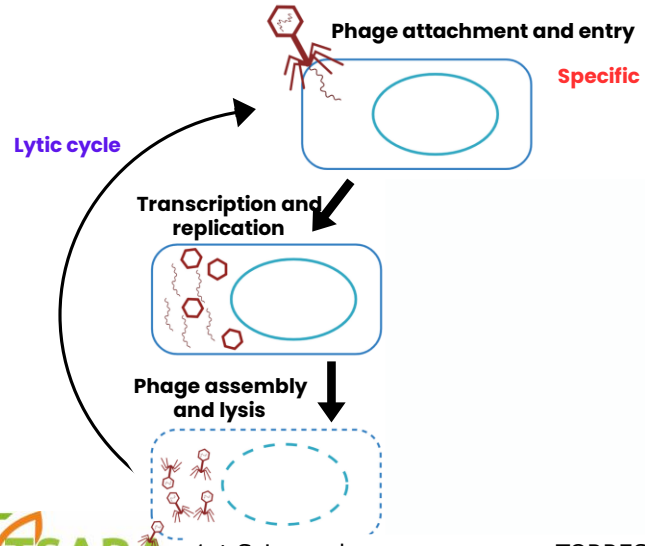
Lab work:

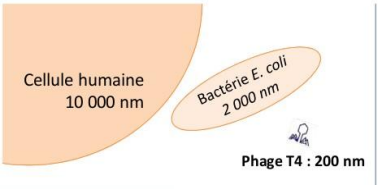
Judicael ANJARAFANOMEZANA
Sarah DELAFOSSE
Mathilde HUTIN
Clara TORRES-BARCELÓ
Lionel GAGNEVIN

Bioinformatics and sequencing :

Ian Quibod
Alexis Dereeper
Florence Auguy
Sebastien Cunnac

Phages life-cycle







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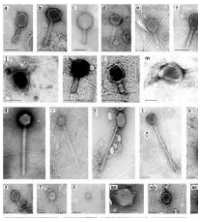
Advantages of phages for applications

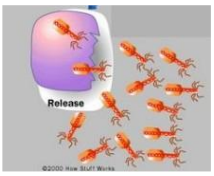
- Phages are numerous and ubiquitous in nature.



- Phages are highly diverse.



- Phages amplify exponentially within bacteria.



- Phages are specific (no risk to beneficial bacteria).



- Phages have the ability to evolve and overcome resistant bacteria.



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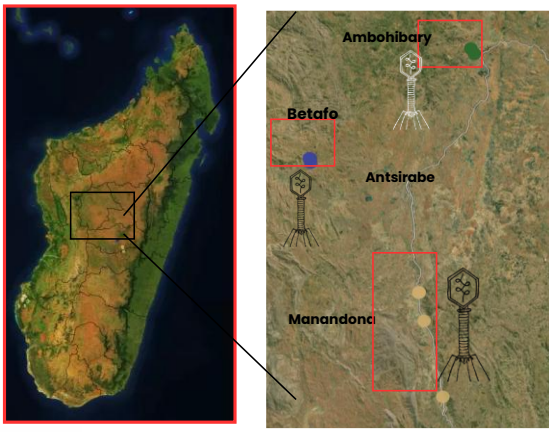
Exploration of *Xoo* Phage diversity in Madagascar (February 2025)





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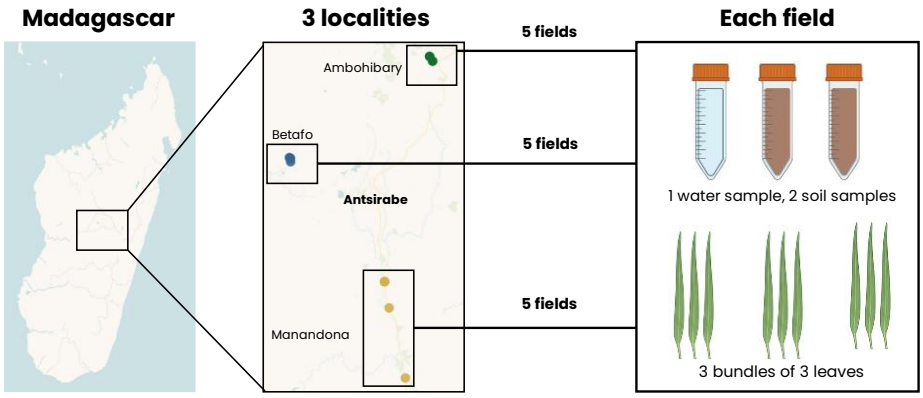
How many samples?



6 samples taken
in 15 fields
90 samples total

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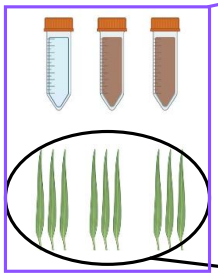
What are we doing with those samples?



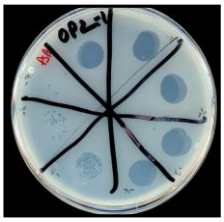




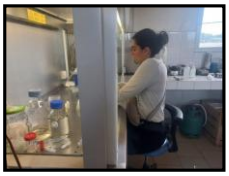
Phage isolation

Bacterial isolation

81 phages



51 *Xoo* strains



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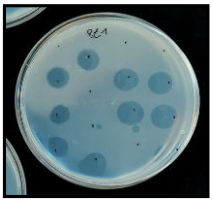
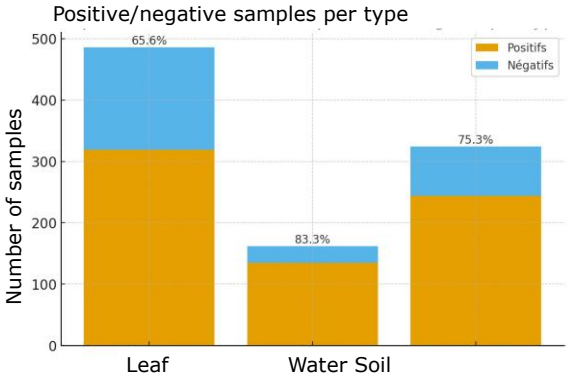
90 samples x 11 *Xoo* strains from the same locality as the sample

990 bacteria/sample pairs

700 positive pairs



80 phages purified



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DNA extraction and sequencing

Phage DNA extraction and sequencing → **80 phages sequenced (ONT)** → **Bioinformatic analysis ONGOING**

Bacteria DNA extraction and sequencing

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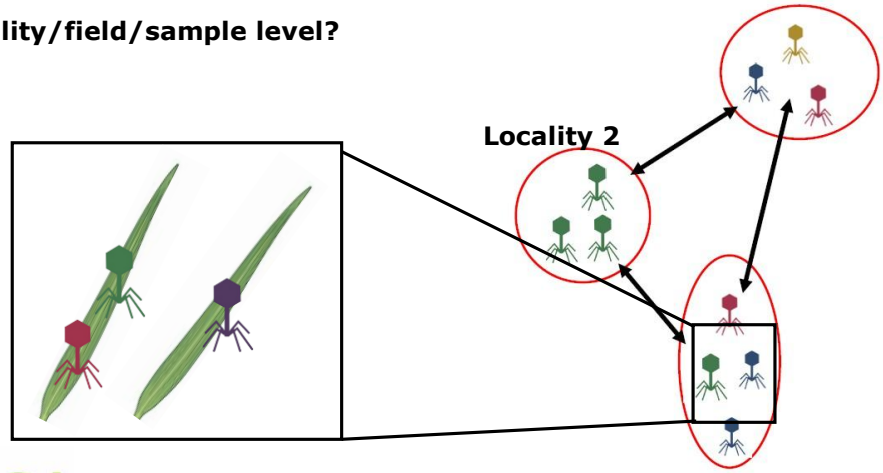
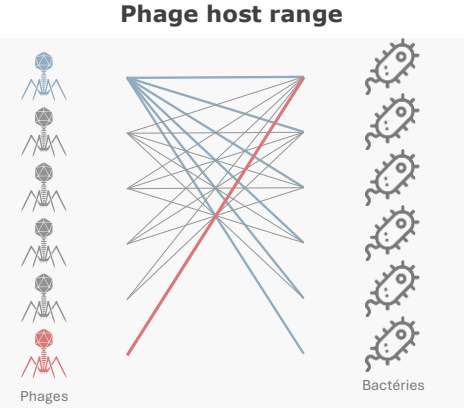
PERSPECTIVES 1/3

Are isolated phages different at the locality/field/sample level?



PERSPECTIVES 2/3

Selecting phages from the collection based on their capacity to recognize local bacterial strains and efficacy



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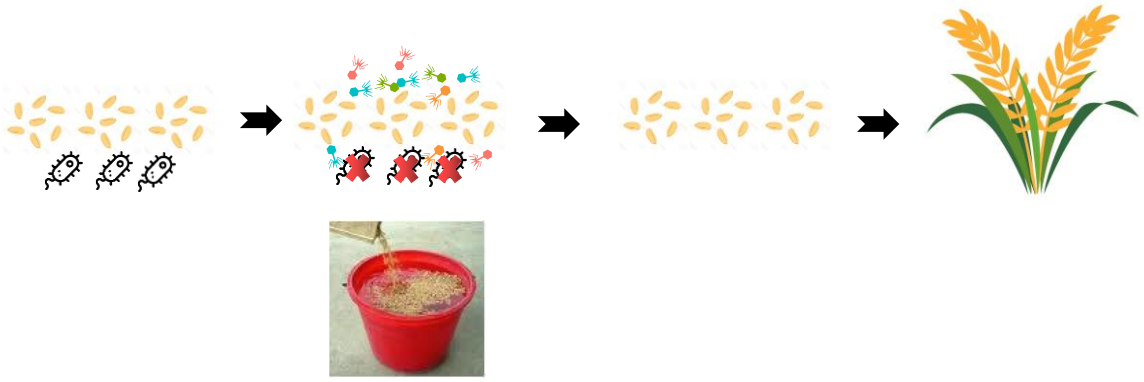
PERSPECTIVES 3/3

Using phages as biocontrol tools to decrease Xoo bacterial load in rice seeds







Field work :

Harinjaka RAVELOSON
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Bioinformatics and sequencing :

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January 20 2026 Phage biocontrol rice

Can local radio stations contribute to epidemiological surveillance?

Remy Decoupes

INRAE, France

Sarah Valentin

Cirad, France

In the context of event-based epidemiological surveillance rather than traditional indicator-based (biological and health) surveillance systems, our objective is to extend our text-mining surveillance tools—particularly PADI-web [1]—to the Indian Ocean (IO), Central Africa, and West Africa regions. These tropical territories are more exposed to epidemiological risks within a One Health framework (plant health, animal health, and public health), due to their geographic location, climatic conditions, and limited resources in communication, equipment, and research and analytical capacities.

Because of these specificities, event-based surveillance approaches relying on text mining and artificial intelligence (AI) are often poorly adapted to the most vulnerable countries, particularly because local languages and specific geographic and climatic contexts are underrepresented in AI training datasets [6]. For example, standard text-mining approaches typically detect only general information, whether in terms of spatial granularity (limited to cities or countries rather than streets or neighbourhoods) or thematic detail (restricted to disease names rather than symptoms). Moreover, event-based surveillance tools rarely integrate information from local media sources, particularly radio, even though these can provide relevant and early epidemiological signals (e.g. symptoms, spatial spread, etc.).

In our work, we focus on the early detection of epidemiological risks through the identification of spatio-temporal and thematic signals, taking into account local languages and communication channels such as radio and newspapers, which are widely used by local populations. This requires integrating automatic speech-to-text processes, which can be challenging when dealing with multilingual and multimodal data.

The methodological work we propose focuses on named entity recognition (e.g. place names) from audio or textual resources in underrepresented languages, such as Creole languages in the Indian Ocean region, or Fulfulde and Peul in Central and West Africa. Large Language Models (LLMs) are now widely used in general applications and in agriculture [1,2]. However, underrepresented languages are poorly captured by these models, and their integration requires adapting existing pipelines [4,5] to better account for local languages in both health and agricultural domains.

The objective of this presentation is to share the current state of our work and future development perspectives, carried out in collaboration between INRAE, CIRAD, and their local partners in the Indian Ocean (SEGA network of the Indian Ocean Commission – IOC), as well as future perspectives in Cameroon. This work is aligned with the “Digital Technology and Agriculture” and “One Health Approach” axes of TSARA.

Rémy DECOUPES
Landy RAJAONARIVO
Maguelonne TEISSEIRE

Thierry BALDET
Mathieu ROCHE
Sarah VALENTIN

Harena RASAMOELINA
Lovena Preeyadarshini VEERAPA-MANGROO

Paulin MELATIAGA

Les radios locales peuvent-elles contribuer à la surveillance épidémiologique ?

Axes TSARA
Digital Technology and Agriculture
One Health Approach

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La veille événementielle





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Les radios locales

Emissions de télévision et de **radio** perçues comme les **principales sources d'information** sanitaire au niveau **local** (Schwind et al., 2014).

Travaux scientifiques préliminaires sur l'analyse de flux radio communautaires :

- En **santé végétale** (Akera et al., 2019)
- En surveillance des **crises humanitaires** (Menon et al., 2018)

Focus sur « *keyword-spotting* »



Lacunes dans la littérature :

- Implémentation automatique de la **collecte** et de l'**analyse** du flux audio
- Application aux **langues peu dotées**
- Evaluation **spatiale** et **thématique** (émergence de maladie, détection précoce, etc.)

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Pipeline et verrous

Verrou :

Dissémination de l'information pertinente
e.g. interlocuteurs multiples, publicités, …

Collecte des flux audio

Transcription

Modèle pré-entrainé
OpenAI Whisper

Filtrage

Extraction d'information
(spatiale, thématique, …)

Verrous :

- modèles non adaptés aux langues peu dotées/régionales
  e.g. français pour créole réunionnais
- mélange de langues (*code-switching*)

Verrou :

Transcriptions bruitées
« *Sylla Hoss* » versus « Cilaos »
« Héro » versus « Hérault »

56

Etats des lieux et perspectives de nos travaux

Etats des lieux

Collecte **Radio Freedom** (la Réunion) depuis août 2025

Partenariats avec **radios du Cameroun** (RFI – fulfuldé)

Montage d'un projet **AI4AfricanLanguages**

Perspectives

Correction des **erreurs de transcriptions**

Approche **phonèmes**

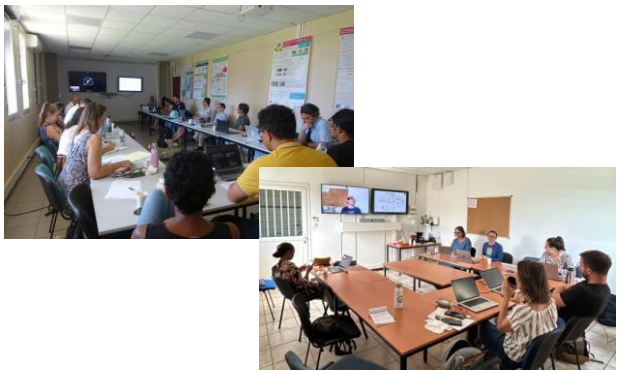
Extension de la zone géographique & collecte de radios

Cas d'étude santé animale, végétale / sécurité alimentaire

57

Evénements associés

Ateliers **océan Indien** (*sémantisation des données en agroécologie, veille événementielle – contexte One Health*)



Atelier *Digital Avenues for Low-Resource Languages of* ***Sub-Saharan Africa*** (Yaoundé, Cameroun)



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Nexus Water–Energy–Food–Ecosystems solutions for resilient Mediterranean territories

Laure Hossard

INRAE, France

The objective of the MORFeuS project is to operationalize the integration and dissemination of combinations of solutions (technical, organizational, and policy-related) toward resilient and sustainable territories. It addresses three main challenges: (i) identifying and assessing the specific combination of solutions needed to enhance the resilience of the targeted territories across the different components of the Water–Energy–Food–Ecosystems (WEFE) Nexus; (ii) building on local stakeholders' knowledge and needs to design combinations of technical and organizational solutions as well as policy instruments; and (iii) assessing the potential for scaling up these approaches and solutions across the Western Mediterranean region. MORFeuS adopts a territorial resilience approach to engage stakeholders, local communities, and decision-makers in the operationalization and co-evaluation of combined Nexus solutions, with the aim of supporting their dissemination for long-term resource management. By mobilizing a Nexus resilience framework, MORFeuS will co-design and operationalize solution packages in large irrigated demonstration sites. These living labs, located in Algeria, France, Morocco, Portugal, and Tunisia, all face severe freshwater resource stress. MORFeuS solutions will combine existing small-scale practices with external innovations. These solutions are of different types: (i) technical (e.g., agroecology, nature-based solutions, water reuse), (ii) organizational (e.g., integrated water management, local food system transformation, renewable energy for collective pumping), and (iii) institutional (policy frameworks). External innovations will build on (i) local experimental experiences from exploratory sites in different countries, and (ii) promising technological innovations (e.g., hydroelectric sensors, on-farm digital tools) for water management and agricultural sustainability. Their combinations and implementation will be carried out in each demonstration site with the active involvement of sectoral stakeholders, farmers, and local communities.

To hybridize different types of knowledge, the project will develop a participatory Nexus approach aimed at territorial resilience and sustainability. MORFeuS will establish territorial living labs in each demonstration site to co-design and operationalize solution packages that enable resilient, efficient, and shared use of WEFE resources, while identifying and addressing institutional and technical bottlenecks. Scaling tools will highlight the cross-sectoral potential of solutions by clarifying their drivers and large-scale impacts to inform policy recommendations. MORFeuS will develop two business models across the demonstration sites: Digi-Advice at farm level and short supply chains. Their development and sustainability will be supported through training activities and the engagement of local entrepreneurs, with the aim of enabling large-scale diffusion and uptake through the MORFeuS network and an international stakeholder platform.

Finally, MORFeuS will identify key insights for implementing the Nexus approach. First, initial and final analyses of the roles and actions of WEFE stakeholders involved in the living labs will highlight sector-specific constraints to collaboration. Second, an analysis of existing sector-driven policy frameworks will support the development of cross-sectoral policy recommendations. Third, these recommendations will be cross-checked with local choices and the implementation of cross-sectoral solutions. MORFeuS will produce policy guidance for effective implementation of the Nexus approach to ensure sustainable resource use, and these results will be widely disseminated through existing networks and dedicated events, including the project's final policy conference.

This project (grant Number 2421), is part of the PRIMA programme, supported by the European Union.

MORFeuS project
Nexus Solutions for Mediterranean resilient territories

MORFeuS
NEXUS SOLUTIONS FOR RESILIENT MEDITERRANEAN TERRITORIES

INRAE · CIRAD · FAR · HSTI · IRD · UM5 · PNR · Fondation Amidoul · CREAD · GIE M'semrir-Tilmi · ENA · IAV · ORVIGNON · University Algarve · ISEG · Rizoma Cooperative · INAT · ACCORD

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MORFeuS: WEFE Nexus solutions for resilient territories

Objective: Co-develop, test and disseminate operational integrated solutions (technical, organizational, governance) towards territorial resilience

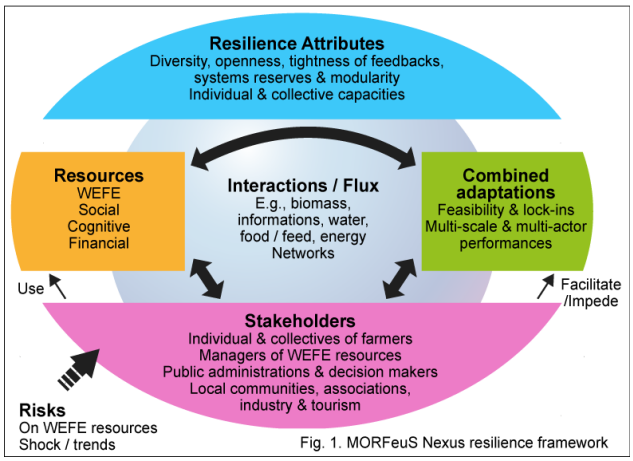

Fig. 1. MORFeuS Nexus resilience framework

- **The concept of resilience for integrated, multi-criteria and multi-scale assessment**
- **A framework to anticipate effects of combined Nexus innovations on different time and scale horizons**

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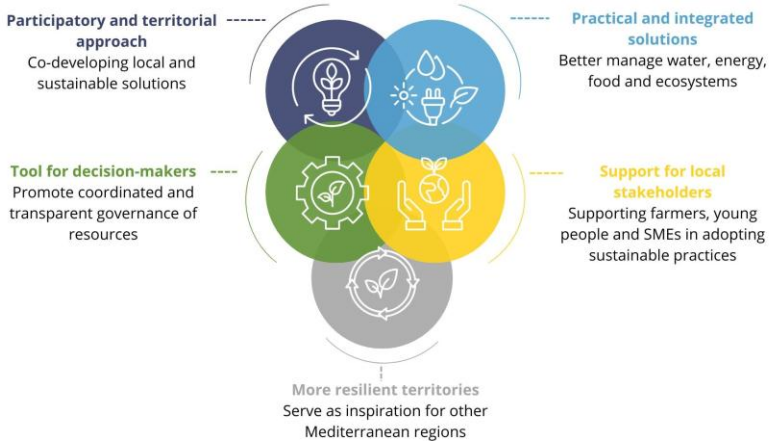
MORFeuS: WEFE Nexus solutions for resilient territories

Objective: Co-develop, test and disseminate operational integrated solutions (technical, organizational, governance) towards territorial resilience



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Participatory approach in the 5 Demonstration sites



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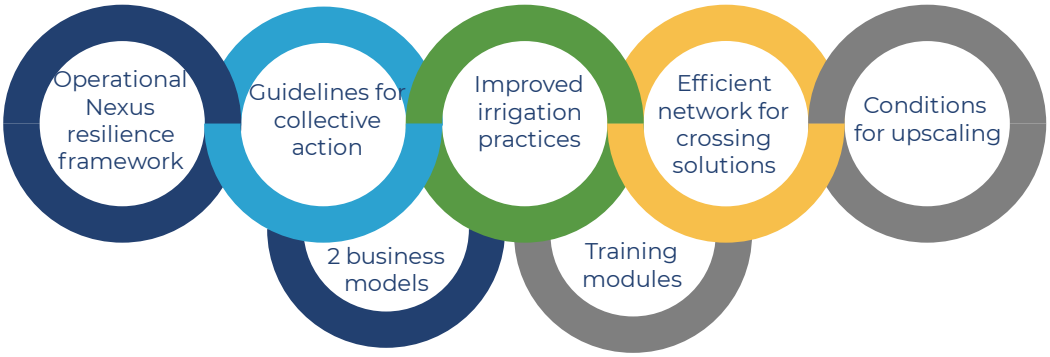
MORFeuS: WEFE Nexus solutions for resilient territories

Key expected results

This project (grant Number 2421), is part of the PRIMA programme, supported by the European Union.



Website: https://eng-morfeus.hub.inrae.fr/

Follow the project:
https://www.linkedin.com/company/prima-morfeus/
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MORFeuS: WEFE Nexus solutions for resilient territories

Electrochemical inactivation of free-swimming parasites; Free chlorine and electric field as potent disinfection agents for *Schistosoma mansoni* cercariae

Begumisa Godfrey Magyezi

Mbarara University of Science and Technology, Uganda

Schistosomiasis (bilharzia) is second only to malaria in global prevalence, affecting more than 240 million people, over 85 percent of whom live in rural sub-Saharan Africa in communities lacking access to potable water and adequate sanitation[1]. Although chemotherapy remains central to control efforts, WHO guidelines emphasize that preventing reinfection requires access to safe water and adequate sanitation[2]. Conventional domestic water treatment methods such as chlorination, filtration, heating and UV disinfection are costly, technically complex and unsustainable for resource-limited rural settings.

Electrochemical disinfection is emerging as a promising alternative because it uses naturally occurring chloride to generate disinfectants *in-situ,* and can be powered by off-grid renewable energy. This makes it a scalable, chemical-independent, location-independent and sustainable option for improving water safety. While electrochemical systems have demonstrated strong efficacy against feacal bacteria and viruses[3], their potential for inactivating free-swimming parasites has not been evaluated. *Schistosoma mansoni* cercariae, the infective larval stage responsible for schistosomiasis transmission, represents a key target for such interventions.

A recent study suggested that cercarial inactivation requires ≥1 mg/L residual chlorine and a contact time (CT) of 30 mg·min/L[4]. Using this benchmark, we conducted electrochemical disinfection experiments varying initial chloride concentration (78, 140, and 350 mg/L), applied current (10, 50, 100 mA), and temperature (20°C vs. 28°C). Two electrode materials were examined: Ru-MMO, a highly efficient chlorine-evolving anode, and graphite, suitable for low-cost field applications. Experiments were conducted in a 250 mL non-divided electrochemical reactor using synthetic lake water containing approximately 10^3 freshly shed cercariae, with cercarial viability assessed microscopically.

With Ru-MMO electrodes at 50 mA, 28 ℃ and 78 mg/L initial chloride, electrolysis generated 1.7 (±0.5) mg/L free chlorine within 30 minutes, resulting in complete loss of cercariae motility. Extending electrolysis to 60 minutes led to clear structural inactivation, indicated by increased numbers of separated heads and tails. Notably, sublethal (intermediate) effects attributed to the electric field alone were observed: cercaria exhibited sluggish movement at 10 mA using Ru-MMO or with graphite electrodes at 50 mA even in the absence of detectable free chlorine. This suggests an additional non-chlorine induced inactivation pathway.

These findings demonstrate the potential of electrochemical treatment as a decentralized, sustainable approach to safeguarding water sources in vulnerable communities. By targeting a neglected parasitic disease, this work contributes new evidence to support environmental health, and reduction of schistosomiasis transmission in rural settings.

Electrochemical inactivation of free-swimming parasites; Free chlorine and electric field as potent disinfection agents for *Schistosoma mansoni* cercariae

Godfrey Magyezi Begumisa *(MUST-INRAE) , Julius Tumusiime (MUST), Casim Umba Tolo (MUST), Grace Kagoro (MUST), Benjamin Gourbal (IHPE), Eleftheria Ntagia (INRAE)*

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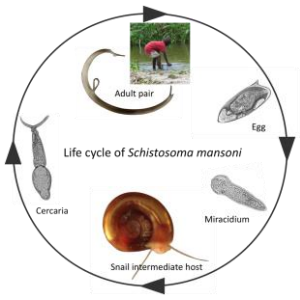
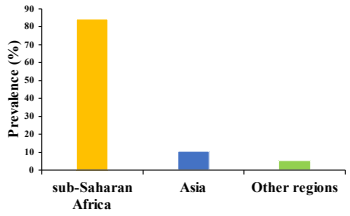
Schistosomiasis: an endemic and water-related illness





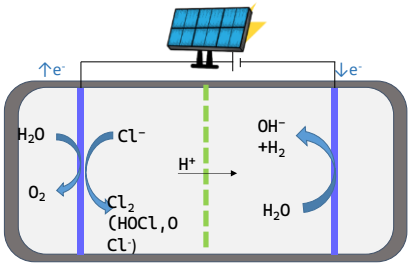
- **Schistosomiasis affects >240 million people worldwide**
  - Reinfection persists despite chemotherapy
  - WHO emphasizes safe water access for prevention
- **Infection:** Two-host lifecycle — **humans and freshwater snails**. Free-swimming **cercariae** from snails penetrate human skin



- ✓ Current treatment practices include chemotherapy (praziquantel), preventive chemotherapy/MDA, snail control using molluscicides, and WASH interventions
- ✓ Current water treatment practices in field include storage, heating, chlorination tablets
- ✓ Practices studied targeting cercariae include chlorination (chemical dosing), UV, Soap, & sand filtration.

Why Electrochemical Disinfection?

- Generates disinfectants *in-situ* from chloride (Cl-) contained in water
  - *No external chemical supply chain required*
  - *Compatible with off-grid renewable energy (solar, doi:10.1016/j.watres.2023.121014)*
  - *Proven efficacy against bacteria and viruses (APHA, 2017; WHO, 2017)*



Effective against bacteria & viruses, but impact on free-swimming parasites is not yet evaluated

Electrochlorination Reactions

- $2Cl^- \longrightarrow Cl_2 + 2e-$
- $Cl_{2(aq)} + H_2O \rightleftharpoons HOCl_{(aq)} + H^+ + Cl^-$
- $HOCl_{(aq)} \rightleftharpoons H^+ + OCl^-,$
- $2Cl^- + H_2O \longrightarrow HOCl + H^+ + 2\,e^-,$

Methods Overview



1. *Biomphalaria* spp. snails 1 – 2 h for cercariae shedding



2. Cercariae shed and lugol stained for counting



3. Stereoscopic observation and cercariae counting, targeting 10^3 - 10^4 cercariae in electrolyzer

1) $[Cl^-]$ = 78, 140, and 350 mg/L
2) Current = 10, 50, 100 mA (25 cm^2 electrodes)
3) Temperature = 20 °C vs 28 °C



5. Stereoscopic observation a of cercariae motility or loss thereof – disinfection effects

Cercariae inactivation was judged as loss of cercariae motility.

I[st] Science Days, January 20 2026 Begumisa Godfrey Electrochemical inactivation of free-swimming Cercariae eleftheria.ntagia@inrae.fr

Schistosome cercariae are effectively inactivated by electrochemical treatment

- Complete loss of cercarial motility within 30 min at 50 mA (CT = 50 mg·min/L)
- Structural damage with extended electrolysis (60 min treatment, 78 mg/L Cl^- -- 50 mA)
- Electric field alone (10 mA), absence of detected Cl_2, caused sublethal effects (sluggish movements after 30 min and 78 mg/L of Cl^-)



The motility and loss of thereof was observed and video recorded at 4× magnification under a stereoscope. All results shared are with Ru MMO electrodes

Conclusions and Implications

First evidence of electrochemical inactivation of cercariae

- Dual mechanism: chemical and electric-field effects
- Promising decentralized water remediation approach
- Supports schistosomiasis prevention at source



http://www.youtube.com/@The_ATRAP_Project

Acknowledgements



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Dr. Grace Kagoro
Dr. Julius Tumiisme
Dr. Casim Umba Tolo
Dr. Benjamin Gourbal
Chrystelle Bureau
Dr. Yannick Fayolle



Dr. Tine Huyse

I[st] Science Days, January 20 2026 Begumisa Godfrey Electrochemical inactivation of free-swimming Cercariae eleftheria.ntagia@inrae.fr

Resilience and functional stability in a sub-humid South African grassland under a decade of climatic and management variability

Lily Munzhedzi

Department Environmental Sciences, University of South Africa, South Africa

Sub-humid grasslands are critical ecosystems that support biodiversity, forage productivity, and ecological stability across southern Africa, yet their responses to increasing climatic variability and management pressures remain insufficiently understood. This study assesses the resilience and functional stability of a sub-humid grassland ecosystem within the Telperion Nature Reserve, located in the Bankenveld region of Mpumalanga, South Africa, over a ten-year period (2007–2017). Using long-term monitoring data, we examine changes in vegetation composition, grazing value, and aboveground phytomass in relation to climatic fluctuations and management practices. High-resolution climatic datasets encompassing interannual rainfall variability and temperature anomalies are analyzed alongside management variables such as grazing intensity (stocking rate), and vegetation cover/bare ground ratio. Statistical analyses, including linear mixed-effects models, repeated-measures ANOVA, and multivariate ordination, are employed to disentangle the relative contributions of climatic and anthropogenic drivers to ecosystem structure and function. Preliminary findings indicate that the Telperion sub-humid grasslands exhibited moderate fluctuations in productivity and vegetation structure over the study period, largely reflecting interannual climatic variability and grazing intensity. Drier years were generally associated with reduced aboveground biomass and increased bare ground, whereas wetter conditions supported enhanced vegetation cover and recovery of grazing value. Aboveground phytomass varied by roughly one-third between dry and wet years, while bare ground proportion fluctuated within a 10–15% range. Vegetation composition showed gradual shifts toward species more tolerant of grazing pressure, though overall species richness remained relatively stable, with mean richness fluctuating between approximately 7.0 and 10.5 species. Preliminary statistical analyses suggest that climatic variability exerted a stronger influence on ecosystem productivity than management intensity, yet both factors interacted to shape grassland structure and function. By integrating climatic and management drivers within a unified analytical framework, this study advances understanding of the mechanisms underpinning grassland resilience under variable environmental conditions. The findings contribute to evidence-based approaches for adaptive conservation and sustainable rangeland management, providing insights into how ecological stability in sub-humid grasslands can be maintained amid intensifying climatic and land-use pressures across southern Africa. Building on these findings, the next step is to investigate the underlying processes and mechanisms through modelling approaches, enabling dynamic simulations that link socio-institutional drivers with ecological outcomes and thereby strengthen predictive capacity for adaptive management.

Resilience and functional stability in a sub-humid South African grassland under a decade of climatic and management variability.

Munzhedzi Lily, Department Environmental Sciences, University of South Africa.

Mangani Tshepiso, Taugourdeau Simon, Bellocchi Gianni, Marquart Arnim, Brown Leslie.

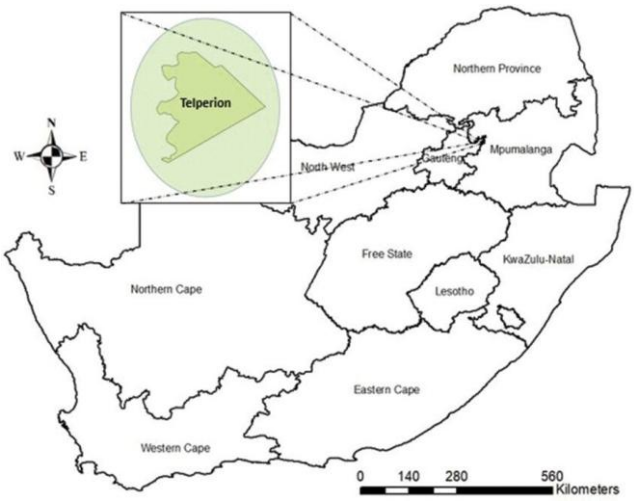
1st Science days Munzhedzi Lily
January 20th 2026

WHY STUDY GRASSLAND RESILIENCE IN SOUTH AFRICA?

- They support livelihoods and food security
- Climate change hits them first—and hardest
- Biodiversity hotspots
- Strong links to water, floods, and disease
- They guide sustainable land management



Study area: Telperion Nature Reserve, South Africa.



Which Data Did We Use?

10 years (2007–2017)

- Biomass
- Species composition
- Rainfall & temperature

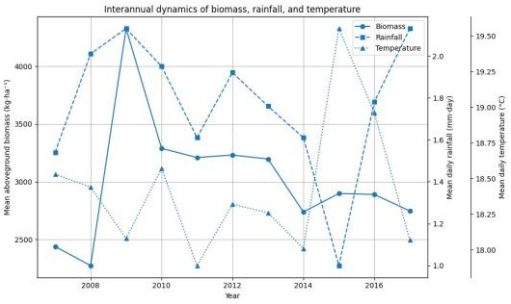
Data Analysis

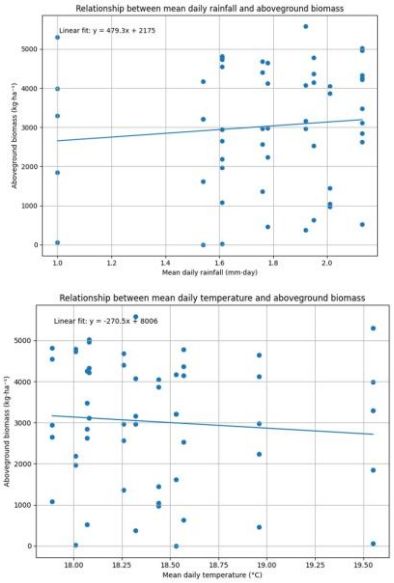
-Time-series summaries,
- Bivariate regression,
- Repeated-measures ANOVA
- Mixed-effects models.





Interanual dynamics of biomass, rainfall and temperature(Preliminary results)





Next Steps

- **Integrate climate and management drivers**
- **Apply modelling approaches (Modvege and Cosmo)**
- **Strengthen predictive capacity**
- **Link ecological outcomes to decision-making**

Posters Interactions agroecology – sustainable food systems

AWA – Agroecology in West Africa

Eric Vall – Cirad

Ninon Sirdey – Cirad

In West Africa, transforming food systems based on the principles of agroecology is a major challenge for promoting more sustainable agriculture and healthier, more balanced diets. However, only a limited number of research initiatives have succeeded in integrating issues arising simultaneously at the production system and food system levels.

Against this backdrop, the AWA (Agroecology in West Africa) project aims to develop an integrated framework for understanding and assessing the drivers and barriers of the agroecological transition, as well as the impacts of agroecological practices, in order to design agroecological innovations that are consistent across the different levels of food systems.

AWA is the flagship South-oriented project of the Long-Term Thematic Programme on Agroecology and Food Systems (PTL2) within the Agriculture, Environment and Biodiversity (AEB) Cluster of the University of Montpellier. It brings together several research units (SELMET, MOISA, ECO&SOLS, AIDA, INNOVATION, HORTSYS, and QUALISUD) and Southern partners from National Agricultural Research Systems (NARS) and universities in Senegal and Benin (University of Parakou and University of Abomey-Calavi). Research will be conducted across a range of territorial contexts and value chains in both Senegal and Benin.

A distinctive feature of the project is its focus on the interfaces between the different components of food systems (production, collection, processing, distribution, consumption, and recycling), between scales (from the farm to the territory), and across scientific disciplines. The project brings together researchers from the social sciences (economics and geography), agricultural sciences (animal science, soil science, and agronomy), and food sciences. This interdisciplinary and multi-scale perspective is expected to generate new insights into the synergies and trade-offs among food system components, thereby supporting a coherent agroecological transition.

To achieve this objective, the project is primarily structured around four PhD projects and two postdoctoral fellowships, each jointly supervised by at least two researchers from different research units and disciplines, ensuring interdisciplinary perspectives and analyses at multiple scales.

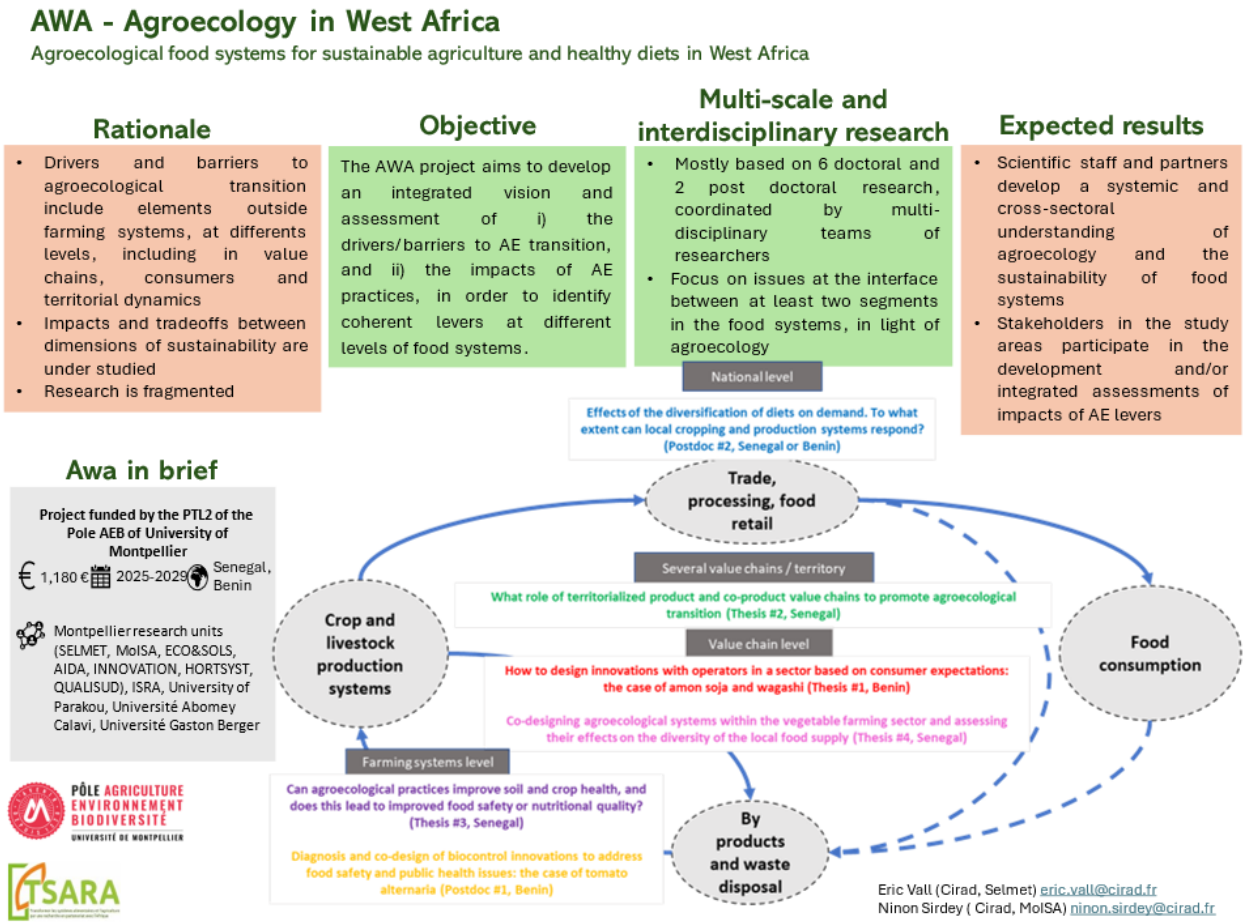
At the agricultural practice level, one PhD project will investigate the effects of agroecological practices on improving soil and crop health, and how these improvements affect the sanitary and nutritional quality of food products (PhD #3, Senegal).

At the value chain level, one PhD project will focus on the co-design of agroecological innovations with stakeholders in the Wagashi and Amon soy value chains, starting from consumer expectations (PhD #1, Benin). A second PhD project will address the co-design of agroecological vegetable production systems and assess their effects on the diversity of the local food supply (PhD #4, Senegal). In addition, one postdoctoral project will develop innovations for the biological control of tomato early blight (Alternaria spp.), addressing both food safety and public health challenges (Postdoc #1, Benin).

At the territorial level, one PhD project will examine how strengthening the territorial embeddedness of product and by-product value chains can foster the agroecological transition (PhD #2, Senegal).

At the national level, one postdoctoral project will model the impact of greater dietary diversification on the capacity of crop production systems to meet changing food demand (Postdoc #2, Senegal or Benin).

Overall, the AWA project proposes an original approach by integrating research activities from two complementary perspectives. The first follows a downstream trajectory, from the upstream stages of food systems (production and collection) towards downstream stages (processing, trade, and consumption) (Postdoc #1 and PhDs #3 and #4). The second follows the reverse trajectory, starting from downstream components of food systems (processing, trade, and consumption) and moving upstream towards production and collection (Postdoc #2 and PhDs #1 and #2).



Climate Change–Food System Interactions and Smallholder Farmers' Adaptation Strategies: Evidence from the Omo River Headwaters, South-Central Ethiopia

Elias Shiferaw, Addis Ababa University

Desalegn Wana, Addis Ababa University

Climate change and variability are intensifying pressure on smallholder food systems in Ethiopia, where livelihoods depend on rain-fed agriculture and fragile ecological conditions. This study investigates the interactions between long-term climate trends, food system components, and the adaptation strategies of smallholder farmers in the Omo River headwaters, south-central Ethiopia. A mixed-methods explanatory sequential design integrates 30 years of meteorological and remote-sensing data (1995–2025) with household surveys (n=360), 12 focus group discussions, and 15 key informant interviews.

Findings indicate a significant warming trend of 0.25–0.30°C per decade, alongside declining and increasingly erratic belg and kiremt rainfall. Drought frequency has intensified since the mid-2000s, with greater unpredictability in seasonal onset and cessation. These climatic shifts are linked to reduced maize and teff yields, rising post-harvest losses, constrained livestock productivity, and worsening household food insecurity. Analysis of food system components shows continued expansion of cultivation into forest margins, increased fertilizer application, and growing livestock density, all contributing to higher greenhouse gas emissions—particularly nitrous oxide from soils and methane from ruminants.

These changes form a reinforcing climate–food system feedback loop: climate variability undermines crop output, prompting farmers to expand cultivation, clear vegetation, overuse fertilizers, and increase livestock numbers to compensate for declining yields. These practices, in turn, elevate local emissions and degrade ecological buffers, heightening sensitivity to future climate shocks. Qualitative insights reveal that although farmers perceive these shifts clearly, their adaptive capacity is constrained by limited irrigation, credit, climate information, and gendered resource inequalities.

The study underscores the need for integrated resilience pathways combining climate-smart agriculture, agro-ecological restoration, early-warning services, and equitable resource access to break the cycle of climate-induced food system vulnerability.

Climate Change–Food System Interactions and Smallholder Farmers' Adaptation Strategies Evidence from the Omo River Headwaters, South-Central Ethiopia

Autor: Elias Tamiru Shiferaw(PhD Candidate), Addis Ababa University
Co-author: Dr Desalegn Wana(PhD), Addis Ababa University

Date January 20-2026

Keywords
Climate change • Food systems • Adaptation strategies • Smallholder farmers • Ethiopia

Climate Change & Food Systems Interactions in the Omo River Headwaters

- Climate change
- Food systems
- Smallholder farmers
- Omo River headwaters
- South-Central Ethiopia

PROBLEM & RESEARCH QUESTION

- Increasing rainfall variability
- Rising temperature
- Greenhouse gas Emissions
- Declining crop & livestock productivity
- Food insecurity risk
- Adaptation Strategies

METHODS & ANALYTICAL APPROACH

- Household survey data
- Temperature and Climate Data
- Greenhouse gas Emission measurement (Tier 1and 2)
- Adaptation practices analysis
- Food-system perspective

Key Findings & Implications

- Crop diversification
- Soil & water conservation
- Livelihood diversification
- Institutional support gaps

Organisation of value chains and agroecological transition of food systems: an exploratory case study in Senegal

Zahra Ndoye – Institut Agro

In Senegal and Tanzania, approximately 40-45% of fruits and vegetables are lost during post-harvest handling due to various factors, including inadequate cold chain facilities and poor technology management. These substantial post-harvest losses not only impact the environment, but also compromise food security, while threatening the economic stability and livelihoods of millions of smallholder farmers. In this context, the AFRICOLD project (2025-2026, TSARA funding) aims to assess current food supply chain systems in Senegal and Tanzania and to propose tailored solutions to reduce post-harvest losses. To carry out this project, three academic partners joined forces: INRAE FRISE (France), UCAD (Senegal), and UDSM (Tanzania).

This article presents an overview of the initial work undertaken on the mango value chain in Senegal. The methodology combined several complementary steps: a literature review, stakeholder identification, and a comprehensive field study. The latter included a socio-technical diagnosis based on qualitative interviews with stakeholders, as well as the monitoring of supply chain infrastructures (storage, transport, etc.) using real-time sensors to collect quantitative data (temperature, humidity, time).

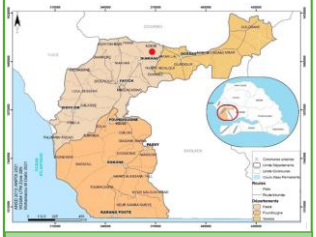
The socio-technical diagnosis was structured in three phases: (i) establishing the theoretical framework, mapping stakeholders, and identifying production zones; (ii) conducting empirical fieldwork in Senegal; and (iii) analyzing the interview transcripts. A total of nine semi-guided interviews were conducted across diverse companies to gather qualitative insights. Participants were selected to ensure representation across stakeholder categories and hierarchical levels. Interviews lasted from 30 minutes to 2 hours and explored eight thematic areas: stakeholder identity, interactions, sector evolution, challenges and solutions, practices, regulation, sustainability, and the cold chain.

In parallel, quantitative measurements (temperature, humidity, and time) were performed along six mango supply chains among the identified stakeholders. Instrumented mango shipments and associated supply chain steps were monitored using real-time sensors. The resulting data were analyzed to characterize temperature and humidity dynamics throughout the chains and to identify potential cold-chain breaks.

The socio-technical diagnosis proved highly valuable for understanding the overall organization of Senegal's mango value chain and the interactions between actors. One of the key findings is the clear structural difference between chains: the absence of a cold chain for the local market, contrasted with a relatively well-controlled cold chain for export-oriented production. Additionally, several issues related to insufficient cold-chain infrastructure were highlighted. The quantitative data collected will used in modelling of mango quality, shelf life, and nutritional attributes using kinetic approaches tailored to the different chains studied.

Value Chain Organization and the Agroecological Transition of Food Systems: An Exploratory Case Study in Senegal

Context



- **Major issue**: declining soil fertility in the Groundnut Basin (Senegal)
- **Causes**: low crop diversification, limited fertilization, post-harvest residue export, soil erosion
- **Possible lever** : more organic fertilization based on increased

Study objective

Analysing the uses and outlets of products and by-products at different level of value chains, to understand to what extent value chains organization may support / inhibit circularity and the agroecological transition ?

Methodology

Case study in Ndiob, Senegal

- **Analysis of lessons learned from the Desira FAIR Sahel project**
- **46 semi-structured interviews with:**

producers and livestock farmers
collectors and traders
ISRA, ANCAR,NGO Enda Pronat
local authorities

- **2 participatory workshops** (July 2024): Producers , local elected officials & technical staff

Analytical Framework

Analysis of value chains organization

Direct and indirect Actors	*What type, what function*
Products and By-products	
Market and non-market-based coordination	*Volume, price, contracts, Service exchanges, mutual support*

Territorial anchoring and agroecology

Ecological anchoring	*Use and valorization of local resources (e.g., recycling residues)*
Socio-economic anchoring	*Interactions between value chains, integration of crop-livestock*
Exected effects	*Biomass and monetary value, increased implementation of agroecological practices*

Results

- **Millet & cowpea value chains locally anchored**
  → Local use and valorization of products and by-products (haulms, bran, stems)
  → Efficient recycling loops: soil fertility, livestock feeding
  → Integration of field crops / livestock / market gardening + source of income for women
- **Groundnut value chain: export oriented**

→ Sale of shells and crop residues outside the territory
→ Biomass leakage and loss of monetary value for the territory
→ Reduced local recycling
→ Dependence on external inputs



Discussed scenario

Establishment of:
a local oil-mill and a composting unit
Capture of 14% of exported volumes
Local retention of:oilseed cakes and shells

Main lessons

- **Territorialized value chains and local mills may promote:**
  - resource circularity
  - Agriculture-livestock synergies
- **Relocalization depends on:**
  - technical factors
  - organization of actors and territorial governance

Perspectives (PhD thesis)

Deepen the understanding of:

i) spatial organization and governance of value chains in contrasted territories and
ii) measuring the role played by territorial value chains to promote circularity and agroecological transition and other outcomes

Bibliographic reference

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Anaerobic Digestion-Mediated Bioactivation of Biochar: Physicochemical transformation and nutrient content alteration for Soil Amendment

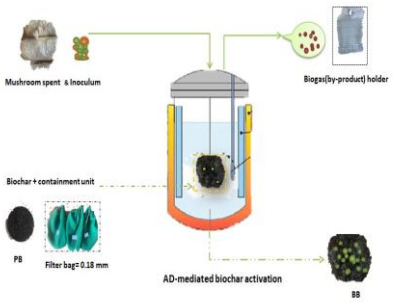
Eniyew Abebaw – Addis Ababa University

While biochar has been recognized for its potential to enhance the stability of anaerobic digestion (AD) processes, the impact of AD-mediated bioactivation on the physicochemical properties of biochar remains underexplored. This study examined the change in the physicochemical properties of pristine biochar after anaerobic digestion-mediated bioactivation. The Pristine biochar (PB) was produced from coffee husk at the temperature of 450 oC whereas the bioactivated biochar (BB) was produced after incubating the pristine biochar for 30 days with methanogenic consortia in the anaerobic digestion. The anaerobic digestion mixture was autoclaved at 121 oC for 15 minute and pristine biochar was soaked to produce sterilized biochar (SB). The results revealed bioactivation reduced porosity due to the formation of biofilm occlusion. The scanning electron microscope showed biofilm-coated surfaces in BB and mineral clogged matrices in SB. Bioactivation of biochar increased the cation exchange capacity by 45 % as compared to pristine biochar. The extracellular polymeric substances were responsible for the higher CEC under the bioactivated biochar. Water retention curves demonstrated enhanced water retention in bioactivated biochar compared to pristine and sterilized biochar. The results also demonstrated a significant increase in nitrogen and phosphorus under bioactivated biochar. The FTIR analysis confirmed microbial functionalization in bioactivated biochar, indicated by the C–O–C and N–H peaks, while sterilized biochar exhibited abiotic oxidation, confirmed by C=O and C–O peaks. This study illustrates that anaerobic digestion-mediated bioactivation tailor the application of biochar for soil amendment through increasing nutrient retention, cation exchange capacity and microbial synergy.

1. QUESTION

This study answer the following questions (i) how colonization by methanogenic consortia alters the surface morphology, porosity, and chemical functionality of biochar; (ii) how nutrient adsorption-desorption processes during anaerobic digestion shape nutrient content of biochar. We hypothesized that anaerobic digestion-mediated bioactivation of biochar altered its physiochemical and nutrient content characteristics for soil amendment .

2. METHODS



3. RESULTS

Table 1. Physicochemical characteristics of pristine (PB), sterilized (SB), and anaerobically digested bioactivated (BB) coffee husk biochars.

Properties	PB	SB	BB
BD(g/cm^3)	0.68± 0.03^c	0.72± 0.04^b	0.95± 0.05^a
pH (1:20 w/v)	9.80± 0.49^a	8.87± 0.44^b	7.24± 0.36^c
EC (ms/cm)	3.97± 0.20^b	4.57± 0.23^a	4.10 ± 0.21^c
SA (m^2/g)	291.73± 14.59^a	460.93± 23.05^c	385.88± 19.29^b
CEC (cmol/kg)	69.63± 3.48^a	80.45± 4.02^b	102.4± 5.12^c
Mass loss relative to PB	-	5.25± 0.26^a	10.2 ± 0.51^b

Table 2. Comparative of macro-nutrient content of pristine, sterilized, and anaerobically digested (bioactivated) biochars.

Properties	PB	SB	BB
TN (%)	0.57±0.04^a	0.76±0.05^b	0.83±0.05^b
TP, (%)	0.35±0.02^c	0.49±0.01^b	0.66±0.05^a
K, K$_2$O, (%)	0.76± 0.04^a	0.63±0.02^b	0.59±0.01^b
Ca (%)	0.86±0.02^a	0.75±0.01^b	0.63±0.1^c
Mg (%)	0.54±0.01^a	0.10±0.02^c	0.093±0.01^b
Na (mg/kg)	178±7^{ns}	180±7^{ns}	190±8^{ns}
S (%)	0.25±0.02^a	0.12±0.03^b	0.1±0.02^b
C_{org} (%)	36±1.44^{ns}	35±1.4^{ns}	32±1.29^{ns}

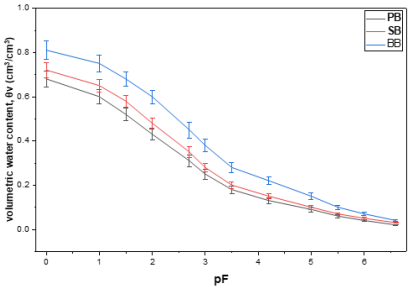


Fig. water retention characteristics of pristine biochar (PB), sterilized biochar (SB) and bioactivated biochar (BB)

4. SCIENTIFIC PERSPECTIVES

Nutrient profile highlighted microbial assimilation's role in modulating nitrogen, phosphorous, and potassium dynamics. The findings also advocate for context-specific biochar applications: pristine biochar for physical soil restructuring and carbon sequestration and sterilized biochar for abiotic nutrient retention in controlled systems. Whereas bioactivated biochar enhancing and revitalizing degraded soils through microbial synergy and enhanced nutrient cycling. The study advances the strategic use of tailored biochars as sustainable soil amendments, offering scalable solutions for agricultural resilience and ecosystem restoration.

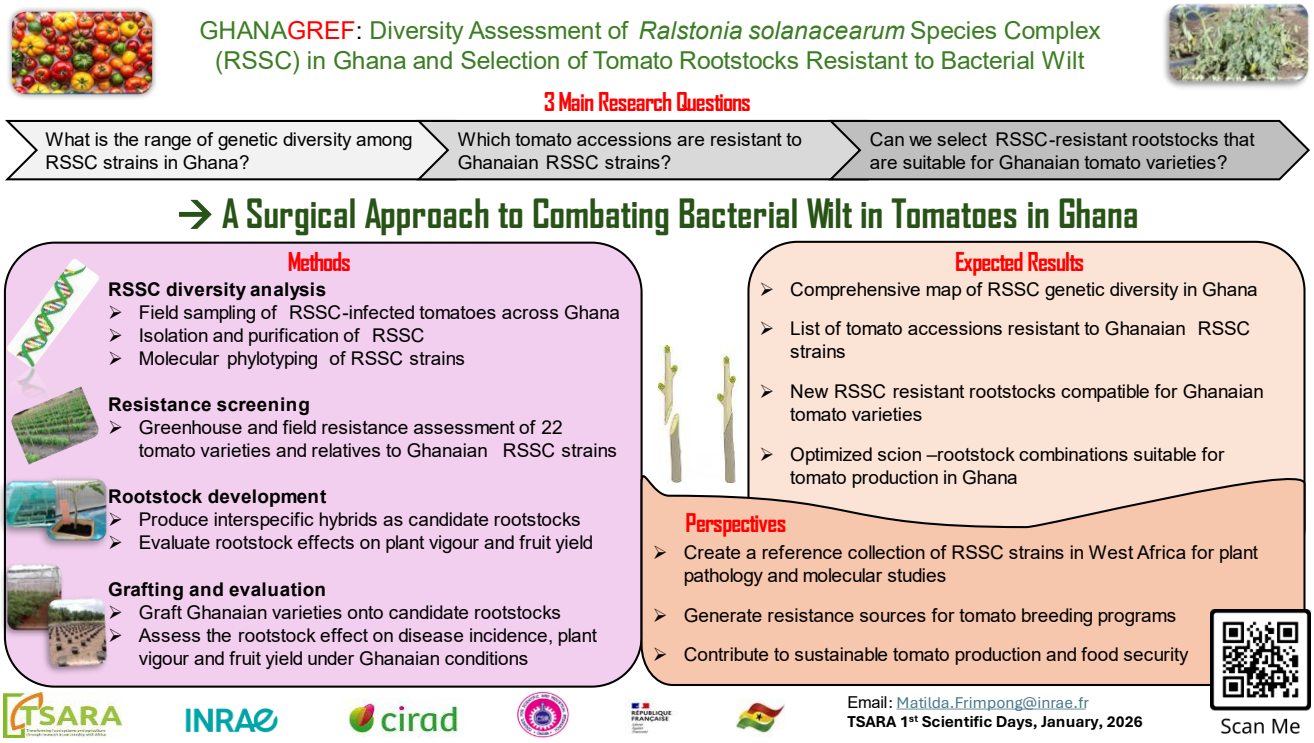
Evaluation of the diversity of Ralstonia solanacearum species complex in Ghana and selection of tomato rootstocks resistant to bacterial wilt disease

Matilda Frimpong – INRAE & CSIR

Tomato is a highly valued crop in Ghana, playing a significant role in the country's economy and food security. However, its production is severely constrained by bacterial wilt, caused by the Ralstonia solanacearum species complex (RSSC), which is among the most devastating diseases affecting tomato, leading to significant yield losses across tropical and subtropical agroecological zones. Despite its impact, knowledge of the diversity, distribution, and pathogenicity of RSSC strains in Ghana remains limited.

This project aims to characterize the genetic diversity of RSSC strains across Ghana's key tomato-growing regions, identify tomato lines resistant to Ghanaian strains and develop tomato interspecific rootstocks with high vigour and resistance to bacterial wilt. PCR-based phylotyping and sequencing will be used, to assess the diversity of RSSC isolates. Tomato lines and wild relatives will be screened under both greenhouse and field conditions to identify resistant lines. The tomato lines will then be crossed to wild relatives to develop interspecific hybrids suitable for use as rootstocks. Preferred Ghanaian scion varieties will subsequently be grafted onto the resulting rootstocks, and scion-rootstock combinations will be evaluated under Ghana's pedoclimatic conditions.

This research is expected to provide valuable insights into the diversity of Ralstonia solanacearum strains in Ghana and to identify potential sources of resistance for sustainable bacterial wilt management, ultimately contributing to improved tomato production and food security in the country.



ANNEX: LIST OF PARTICIPANTS

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