

# STATUS SEMINAR 2025, ACCRA, GHANA

BOOK OF ABSTRACTS



Interfaces



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TUESDAY, 3 JUNE

## **Co-development and transdisciplinary approaches (Chair: Sidy Tounkara, Laure Tall & Brigitte Kaufmann)**

### **The INTERFACES approach to knowledge and innovations brokerage in northern Ghana**

*David Anafo (anafo.d@wascal.org), Peter Asare-Nuamah (pasarenu@uni-bonn.de), Constance Akurugu, Tina Beuchelt*

INTERFACES works with local stakeholders at the micro and meso levels to promote knowledge and innovations uptake for sustainable land management. The approach adopted by INTERFACES is two-pronged. INTERFACES established a multi-stakeholder participatory learning platform (PLP) that brings together diverse actors in the land use and land governance ecosystem to promote gender-responsive learning, reflection and action on sustainable land management and identify jointly pathways for change. The Platform is envisaged to serve the purpose of a knowledge and innovations broker to smallholder farmers in northern Ghana and to promote science-driven policymaking at the policy level. We document the processes followed in establishing the Ghana PLP, the activities and achievements of the Platform including the development of theory of change (ToC), and the planned activities over the life of the on-going projects and beyond.

### **Combining the living lab and farmer's field schools approaches in a System of Rice Intensification (SRI): lessons learned and challenges in the Senegal River Valley (Podor)**

*Sidy Tounkara (sidy.tounkara@ipar.sn), Laure Tall (laure.tall@ipar.sn)*

Through participative and inclusive implementation using the living lab approach, the COINS project has made it easier to achieve its objectives and anticipate difficulties in appropriating its results. In addition, the Farmer's Field Schools approach was combined with this participatory and co-creation method to build farmers' capacity to master the technology of the System of Rice Intensification (SRI). The experience developed in the Senegal River Valley, particularly in the Podor department, has made it possible to facilitate the implementation of research activities conducted by international partners, to give greater robustness to the foresight exercise on sustainable land management, to train adult producers in SRI, to integrate environmental assessment into Farmer's Field Schools, and so on. However, this combination of living lab and Farmer's Field Schools to promote SRI technology has revealed a number of challenges. These include the governance of producers' organizations, the objective constraints linked to the production environment and, above all, the need for feedback from scientists and interaction with living lab stakeholders to discuss, amend and improve research results.

### **Collaborative Pathways: Building Transparency and Co-ownership in Transdisciplinary Research**

*Maria J. Restrepo (m.restrepo@dtisl.org), Mareike Voigts, Brigitte Kaufmann*

Transdisciplinary research (TDR) has proven effective in addressing complex societal challenges by integrating knowledge from different disciplines and engaging with societal stakeholders at eye level. However, stakeholder collaboration cannot be taken for granted, nor are researchers always equipped with the skills necessary to facilitate meaningful knowledge co-creation. To increase transparency, empower community stakeholders as co-researchers, and promote shared decision-making rather than one-sided information sharing, we established 14 InfoRange Community Committees in the project areas in Namibia and Kenya, including representatives of traditional authorities, livestock owners, and herders proposed by the respective communities. Regular committee meetings were designed as a platform for dialogue, where Masters and PhD students presented their research plans or preliminary findings and received feedback from committee members. We supported students in preparing for these presentations, emphasising clear, respectful, and non-hierarchical communication of academic topics to non-academic stakeholders - skills that are rarely taught in universities and academic settings. These activities help to ensure that committees can actively shape research design, tools, data interpretation, and ethical considerations that are grounded in local knowledge, needs, and lived experiences. This collaborative process enhances the relevance, usability, and fairness of the research, while promoting shared learning and community ownership of the process.

## **Building Bridges: Co-development and transdisciplinary approaches**

*Carina Lange (carina.lange@dfki.de), Eyram Victoire Tsamedi (yaeyram@gmail.com)*

Co-development and transdisciplinary approaches are essential for addressing complex challenges by integrating diverse perspectives and fostering collaboration across disciplines and sectors. Both approaches are widely applied in fields such as sustainability science and innovation. Their intersection enhances problem-solving by combining theoretical insights with practical applications, leading to more inclusive, and context-specific outcomes. This presentation will explore a co-development approach that leverages local students as intermediaries between academic research and local knowledge to address complex challenges such as the impacts of climate change on rural African communities. Through participatory processes, we aim to co-create contextually relevant technological solutions by integrating scientific knowledge with local expertise. The presentation will showcase specific project examples demonstrating how this approach fosters mutual learning and knowledge exchange, enabling farmers to enhance their resilience through the development and adoption of innovative and sustainable agricultural practices.

## **Beyond the Screen: Understanding and Co-Creating App Features with Kenya's Rangeland Pastoralists**

*Rufo Halakhe (r.halakhe@ditsl.org), Maria J Restrepo, Brigitte Kaufmann*

Co-design is an iterative and participatory methodology that actively involves users in developing technologies tailored to their needs. While its potential to produce user-centred solutions is widely acknowledged, much of the existing literature focuses on the early stages of co-design. This leaves significant gaps in understanding how the entire process unfolds, including the practical barriers encountered, the enablers leveraged, and the strategies used to refine outcomes. This presentation addresses these gaps by guiding through a comprehensive and iterative co-design process, to develop a digital application to enhance resource monitoring with pastoral livestock keepers in northern Kenya. The process includes four key phases such as 1) collective catalysing, 2) collective understanding & exploring, 3) progressive PD with 'co-design team' and 4) collective doing & learning. Low-fidelity prototypes are used initially to provoke creativity and discussion, while high-fidelity prototypes are introduced later for instant utility, enabling participants to interact with realistic app designs and provide actionable feedback in the co-design workshops. Systematic reflections on the co-design process provide detailed insights into the iterative development journey, identifying usability challenges and opportunities for refining the app's functionality.

## **Soil management (Chair: Michael Asante)**

### **Carbon and water dynamics in maize-based system under different tillage practices in the savannahs of Ghana**

*Michael Asante (mkasante08@yahoo.co.uk)*

An increasing world population and change in consumer preferences necessitate the need to increase food production to meet the demand of a changing world. Intensified agriculture and accelerated climate crisis with increasing weather extremes threaten the resource base needed to improve crop production. Maize is an important staple food in Ghana. However, yield obtained by farmers in Ghana is relatively low due to low soil fertility status. Integrated Soil Fertility Management (ISFM) strategies have proven to sustainably increase maize yield. However, majority of farmers practicing ISFM till their land conventionally, potentially resulting in substantial CO<sub>2</sub> emissions that contribute to global climate change. Field trial was conducted in Ghana to investigate the impact of different tillage practices and ISFM technologies under maize cultivation on seasonal CO<sub>2</sub>, grain yield, net ecosystem carbon balance and water use efficiency using a low-cost CO<sub>2</sub> monitoring system. A split plot design was used for the experiment. The results showed that conventional tillage system emitted right after tillage operation 65% and 87% more CO<sub>2</sub> into the atmosphere than the reduced tillage and No tillage respectively. Also, combined application of organic and inorganic fertilizers at 5 t ha<sup>-1</sup> and 90-60-60 kg NPK ha<sup>-1</sup> respectively, enhanced maize grain yield.

## **Participatory soil mapping in Benin assisted by gamma ray measurements**

*Chike Onyeka Madueke (chikeonyeka.madueke@uni-hohenheim.de)*

Sound environmental data, especially soil data, is essential for developing land evaluation and decision support tools. A participatory strategy based on local terminology may be crucial to bridging the language gap between farmers and academics and ensuring efficient communication, especially if future land use alternatives at the village level need to be selected. Nevertheless, it is safer to establish a soil map on extra observations or measurements in addition to local knowledge.

Gamma ray spectrometry is an increasingly important tool for the proximate and remote sensing of soil information. In this case study in the village of Boukoussera, Benin, gamma spectroscopy measurements were used to verify and update the indigenous soil map generated via local expert interviews. Some of the basic steps undertaken include:

1. Indigenous soil mapping based on satellite image interpreted by local experts.
2. Soil profile description within the key units and reference gamma ray measurements.
3. Gamma ray measurement and soil augering in the village territory (in a multiple zigzag pattern).
4. Cluster analysis of gamma/augering data.
5. Adjustment of indigenous soil map based on the cluster results.
6. Verification of the map on the ground with local experts.
7. Final elaboration of the map based on GIS technology.

The resultant local soil types include Jaaleri, Baaduni, Taaduni and Loope. Two different Loope may, however, be differentiated using the gamma measurements. This may be attributed to difference in the clay content of these soils. Using cluster analysis, the indigenous soil map was readjusted into 7 units. These would be assessed further to produce the final soil map and memoir.

## **Assessment of the micronutrient dynamics of Northern Ghana, supported by gamma ray measurement**

*Chike Onyeka Madueke (chikeonyeka.madueke@uni-hohenheim.de), Amisu Mohammed (mohammedamisu@gmail.com)*

In 2021, it was reported that up to 70 % of the population of sub-Saharan Africa suffer from the impacts of food insecurity and hunger. This is made even more acute by the phenomenon of hidden hunger, which reportedly afflicts one-third of the global population. What makes it more debilitating is that, unlike physical hunger, it cannot be felt, and the negative impacts would usually have occurred before the need for corrective measures is even noted. Iodine, Zinc and iron deficiencies, among others, can adversely affect the immune system, growth and wellbeing of children. These nutrients are largely soil-borne. As such, if these soil micronutrients are available in adequate amounts, plants would absorb them, and the animals and humans that consume those plants would equally have them in adequate amounts for healthy growth and survival. Consequently, a good knowledge of the spatial distribution of these micronutrients would enable site-specific soil management and fertilization for proper and improved human nutrition. Data on soil micronutrients is, however, grossly inadequate in sub-Saharan Africa. As such, the major objective of this study is to develop a methodology for easy and rapid mapping of soil micronutrient in the sub-region.

About 100 auger soil samples were taken along a 290 km road transect to enable the classification of the soils. Surface samples were also collected for laboratory analysis. To develop a model for extrapolating the soil data to unsampled areas, the gamma spectroscopy of the sampled sites was measured. Air-borne gamma spectroscopy data was also acquired from the Ghana Geological Survey Authority.

Results show that iron and manganese are available in adequate amounts. Copper content was predominantly low, while zinc and molybdenum were generally very low.

## **Distance from shea tree effect on soil CO<sub>2</sub> emission and microbial community structure**

*Deogratias Kofi Agbotui (deogratiasagbotui@yahoo.com)*

The hypothesis of the study is that CO<sub>2</sub> emission will reduce with distance away from shea tree because litterfall and decomposition and root turnover will be higher under tree canopy. To this end four isolated *Vitellaria paradoxa* trees were selected in farmer fields whereby each area of tree influence was delineated into canopy area (Zone A), 3 m away from canopy (Zone B), 10 m away from canopy (Zone C), and 20 m away from canopy (Zone D).

**Poster session: Co-developing innovations for sustainable land management in African small holder farming systems (Chair: Jonas Meier)**

**Farmers' perceptions and native knowledge on soils and fertility management in northern savannah of Ghana**

*Amisu Mohammed (mohammedamisu@gmail.com)*

Northern Ghana is often characterized with inherently low soil fertility and low agricultural productivity, posing a serious challenge on sustainable farming practices. Smallholder farmers who form the backbone of the region's agriculture, possess valuable indigenous and perceptions regarding soils and soil fertility. However, these knowledges are often overlooked bringing a knowledge gap between researchers and smallholder farmers. This study combined farmer survey and soil sampling to identify native farmers knowledge on soils and possible soil fertility indicators, and assessment of these indicators with scientifically measured parameters.

**Following micro-dosing and integrated soil fertility management innovations in northern Ghana: challenges and prospects for stakeholders**

*Emmanuel Theodore Asimeng (theodore.asimeng@idos-research.de)*

Follow the Innovation (FTI) is a method designed to support innovation development with the ultimate goal of achieving adoption by the intended users. The approach emphasizes active participation of from all stakeholders. In northern Ghana, The FTI method was applied to two innovations: fertilizer micro-dosing and integrated soil fertility management (ISFM). This poster presents documentation of the innovation development process, highlighting success, challenges, areas for improvement in future projects, and the potential for large scale adoption.

**Measure for Impact - Mapping Field Boundaries and Developing Tailored Digital Learning Resources to Support Effective Land Management**

*Valerie Graw (valerie.graw@rub.de), Niels Dedring, Niklas Heiss, Janet Mumo Mutuku, Celeste Tchapmi Nono Nghotchouang, Andreas Rienow, Stefanie Steinbach, Laure Tall, Frank Thonfeld, Sidy Tounkara, Pierre C. Sibiry Traore & Jonas Meier*

Accurate field boundary information is critical for effective land management, agricultural planning, and policy-making. In West Africa, smallholder farmers often lack precise field size knowledge, leading to inefficient resource use and reduced yields. Digital tools and Earth observation (EO) data offer new opportunities to empower farmers and tailor policy interventions to local needs.

This work focuses on northern Ghana and northern Senegal, two regions with distinct agricultural systems. Northern Ghana's diverse crops and management practices require adaptable tools, while northern Senegal, dominated by irrigated rice in the Senegal River Valley, benefits from efficient boundary detection to optimize input use. The COINS project is developing region-specific solutions to address these needs. In Senegal, convolutional neural networks (CNNs) trained on Planet satellite data automate field boundary detection, integrating results into the agCelerant platform to support sustainable intensification (SI). In Ghana, a farmer-centric tracking app addresses the complexity of its agricultural landscape.

Participatory approaches ensure these tools align with local realities, combining farmer expertise with satellite data. Knowledge sharing through the agCelerant Academy Mobile and e-learning materials bridges the gap between advanced technologies and grassroots adoption, enhancing farmer agency while informing more effective policies for sustainable agriculture.

## **Effect of Amorphous Silica (ASi) on N fertilizer induced GHG emissions for different, major agro-ecological zones of West Africa**

*Yvonne Ayaribil (yvonne.ayaribil@zalf.de), Malena Schwinekoeper, Mathias Lück, Michael Asante, Geoffrey Sossa, Maren Dubbert, Sidy Tounkara, Paul Ndiaya Ciss, Jörg Schaller, Mathias Hoffmann*

Droughts and dry spells are increasingly common in sub-Saharan Africa, posing significant stress on crops. At the same time, increasing crop yields is essential to meet the demands of a growing population. Amorphous silica (ASi) enhances crop resilience to drought, making it a promising mitigation strategy for the region. However, its impact on fertilizer-induced greenhouse gas emissions, particularly nitrous oxide (N<sub>2</sub>O), remains unclear. Here we present N<sub>2</sub>O, CO<sub>2</sub> and CH<sub>4</sub> emissions of a longer-term incubation study, investigating GHG emissions following mineral and organic N fertilizer application for two major cropping systems, typical for western, sub-Saharan Africa, namely maize and wet-rice. In total, four different soils from three different countries (Senegal, Ghana and Benin), representing four different agro-ecological zones of West Africa have been investigated. Our results show that ASi substantially reduced N<sub>2</sub>O emissions especially under mineral fertilization (up to 60%), irrespective of soil type or soil water conditions (dry vs. flooded). No distinct influence on CO<sub>2</sub> and CH<sub>4</sub> emissions as well as under organic fertilization was found, however. This emphasizes the important role silica amendments might have for not only drought mitigation but also reduced GHG emissions and thus an improved sustainable intensification of the agricultural sector of Sub-Saharan Africa.

## **A Review: Potential of Earth Observation (EO) for Mapping Small-Scale Agriculture & Cropping Systems in West Africa**

*Niklas Heiss (niklas.heiss@dlr.de)*

West Africa faces a complex range of challenges arising from climatic, social, economic and ecological factors, which poses significant risks. The rapidly growing population, coupled with persistently low agricultural yield, is worsening the situation. A state-of-the-art monitoring and data derivation of agricultural systems are crucial for improving livelihoods and enhancing food security. Despite smallholder farming systems accounting for 80% of cultivated cropland area and providing about 42% of the total employment in West Africa, there exists a lack of a comprehensive overview of Remote Sensing (RS) products and studies specifically tailored to smallholder farming systems. Through a systematic literature review comprising 163 SCI papers sourced from the Web of Science database, we analyze the RS sensors, spatiotemporal distribution, temporal scales, the crop types examined, and thematic foci employed in existing research. Our findings highlight the predominance of high to very high-resolution multispectral sensors as the primary data source and we observe that a wide array of available sensors and datasets, along with increasing computing capacities, have shaped the field over the last years. By synthesizing existing knowledge, this study identifies the potential of RS and pinpoints the key research gaps. This sets the stage for future investigations aimed at addressing critical challenges in West African smallholder agricultural systems.

## **Investigating roles of sustainable intensification practices in Ghana cropping systems using crop modelling approaches**

*Thuy Huu Nguyen (tngu@uni-bonn.de), Bright Sallah Freduah, Amit Srivastava, Jesse Naab, Madina Diancumba, Dilys Sefakor MacCarthy, Kwasi Godfried Samuel Adiku, Heidi Webber, Thomas Gaiser*

Successful upscaling of sustainable intensification (SI) practices from specific locations to regional scales requires further investigating the suitability of SI, especially under highly spatial and temporal heterogeneity of soil, seasonal climatic characteristics, and local inputs (e.g. fertilizers and residues). Understanding of SI performance across locations could be based on comprehensive field trials which are often lacking in Africa. In such a backdrop, dynamic crop modeling systems incorporating SI practices [e.g. crop residue retention or varied nitrogen (N) and phosphate (P) applications in crop rotation system] theoretically offer opportunities to investigate the effects of those SI practices on crop yield and soil nutrients (including mineral N, soil organic carbon, and total nitrogen). In this study, we used two crop growth models (SIMPLACE <LINTUL5> and APSIM) along with the existing field measured data for the maize-soybean rotation system in Northern Ghana. Changes in simulated yield and soil nutrients corresponding with step-wise incremental changes of previous crop residues (0, 25%, 75%, and 100%) as well as applied N (0, 30, 60, and 90 kg N ha<sup>-1</sup>) and P (0, 15, and 30 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) were evaluated. The calibration of both crop models relied on the biomass and grain yield measurements from the 2010 sole maize crop. Compared to the observed biomass data, bias errors were

recorded at 0.314 and 0.328 ton ha<sup>-1</sup> for LINTUL5 and APSIM, respectively. During validation across different years, both models consistently overestimated biomass and yield in 2011 and 2012, with bias errors around 0.9 ton ha<sup>-1</sup>, while underestimating grain yield by approximately 0.5 ton ha<sup>-1</sup> in 2013. The LINTUL5 model successfully captured the positive impact of crop rotation (soybean-maize-soybean-maize) on maize grain yield. Nonetheless, it was noted that the observed increase in maize grain yield after rotation seasons was higher than the simulated yield increment within this model. These findings indicate the necessity of considering the spatial variations in crop residue retention and chemical fertilization inputs in the farmer fields while upscaling model applications from field to regional scales.

## **Coping and Social Cohesion Mechanisms in Addressing Climate Change and Land Degradation in Ghana**

*Hycent Tim Ndah (h.ndah@uni-hohenheim.de), Harry Quaye Amankwah, Johannes Schuler*

The West Africa sub-region is faced with major interlinked challenges in ensuring sustainable livelihoods in the context of climate change and land degradation. To ensure sustainable food production and resource use, agriculture needs to be resilient through the application of responsive adaptation and coping strategies. While many studies have explored coping and adaptation strategies employed by farmers, little attention has been paid to the farmers' indigenous practices and the role of social cohesion mechanisms. Using the sustainable livelihood framework, this study addressed this gap by exploring coping strategies and social cohesion mechanisms used by smallholder farmers in northern Ghana. It made use of a mixed-method approach, including a household survey, focus group discussions, expert interviews, field observations, and key informant interviews. Data was collected from 60 households in 6 communities across 3 districts in the study region. The results showed that social assets such as membership to self-help groups were the most important source of coping, particularly for the most vulnerable households. Such membership enabled farmers to secure micro-loans and receive aid from fellow members during extreme climate events such as floods. Farmers' tacit knowledge emerged as pivotal in coping with climate change and enhancing soil fertility, encompassing traditional weather forecasting, the making of biopesticides, and sustainable land management practices such as ridge and bund creation and intercropping. Key coping practices reported by the study participants included reduction of food consumption, off-farm jobs, selling livestock, charcoal making and reliance on remittances. The results further revealed that social cohesion mechanism or collective action plays a key role in helping farmers cope and adapt to climate change while improving soil fertility. Social cohesion is mainly reflected in two different structures depending on gender. While diverse challenges of innovation adoption exist, socio-cultural barriers differ by gender. The study recommends the integration of farmers throughout the innovation development process and proposes the need for a concerted effort to strengthen land tenure security policies, ensuring equitable access to farmlands for all genders.

## **Farmers' perceptions of the effects and preconditions for scaling sustainable intensification (SI) practices: A case of System of Rice Intensification (SRI) and Integrated Soil Fertility Management (ISFM) in Podor and Dagana, Senegal**

*Hycent Tim Ndah (h.ndah@uni-hohenheim.de), Johannes Schuler, Sidy Tounkara, Celeste Tchapmi Nono Nghotchouang, Khadidiatou Faye, Javier Miranda, Heidi Webber, Pierre Sibiry Traoré, Frank Thonfeld, Jonas Meier*

The rapid increase in population and the scarcity of agricultural resources in sub-Saharan Africa (SSA) present substantial challenges to the sustainable productivity of agriculture. Sustainable intensification (SI) practices are gaining attention as a promising approach to enhance food security and farmers' livelihoods while curtailing environmental degradation. The fundamental objective of SI practices is to enhance the productivity and efficiency of agricultural systems within the same geographical area while concomitantly mitigating the adverse environmental impacts. SI practices, including Integrated Soil Fertility Management (ISFM) and System of Rice Intensification (SRI), have been identified as promising solutions. However, their adoption remains limited due to unfulfilled expectations, challenges related to the local context, lack of financial capital and perceived shortcomings.

This study explores the perceptions of small-scale farmers regarding the effects of sustainable intensification practices, with a particular focus on ISFM and SRI in two regions of northern Senegal. Specifically, the study i) examines farmers perception of ISFM and SRI effects on productivity, resource use, production costs and effort, quality of life, and well-being; ii) evaluates the gap between trainings received and expected, iii)

assesses effects on youth and women, and iv) identifies reasons for dis-adoption and limited scaling. Data was collected through a standardized questionnaire, administered to 500 farmers across the two regions in the Senegal River Valley: Podor and Dagana. Results revealed heterogenous responses across the regions. Crop rotation has been identified as the most common ISFM practice in both regions, followed by crop association and organic fertilizers (in Podor), and crop-livestock integration (in Dagana). ISFM in Dagana is associated with higher yields, lower costs, and general improvement in quality of life, although water use remains a concern. In Podor, ISFM benefits are less clear, with many farmers reporting no improvements in yields or quality of life. Regarding SRI, most farmers have received so far only a minimal one-time training or non, contrary to their expectation of more than three training sessions for a proper comprehensive of the technology. SRI practices such as plant replication and soil drainage are commonly implemented, while seeding in lines and mechanical weeding are rarely adopted. Youth involvement in the practice of SRI is increasing, though with a low presence in Farmers Field Schools (FFS), and farmers perceive it as reducing women's labour but increasing men's workload. Primary reasons for SRI abandonment include lack of equipment, insufficient trained labor, irrigation challenges and the arduous and time-consuming nature of the work in the SRI process. These findings highlight the importance of tailoring interventions and training to the specific needs and realities to support the broader adoption of SRI in the Senegal River Valley.

### **Risk management strategies for smallholder farmers in Northern Ghana**

*Johannes Schuler (schuler@zalf.de)*

Variability in seasonal and interannual rainfall, together with acute vulnerability to food price spikes, lead to a situation in which farmers' investments to increase productivity are very risky. Any support that could reduce the risk of investing in agriculture would help farmers to pursue options to build soil fertility and/or intensify production, thereby improving incomes and reducing poverty. Under current conditions, livestock often constitute a main source of insurance against crop yield failures, with the result that the region's crop and livestock systems often drive farmers towards unsustainable pathways. Crop residues are fed to livestock leading in many cases to soil nutrient mining and increasingly degraded soil fertility challenging long term efforts at sustainable intensification. Based on the results of a tested bioeconomic farm modelling approach for different risk scenarios, a simplified tool is presented which indicates which risk management options can improve farmers' resilience against shocks.

### **The role of financial incentives in technology adoption: evidence from a framed experiment in Northern Ghana**

*Javier Miranda (javier.miranda@ilr.uni-bonn.de)*

Smallholder farmers in Sub-Saharan Africa face multiple barriers to adopting improved agricultural technologies, including financial constraints and uncertainty about seasonal rainfall. Improved seed varieties offer a promising strategy for increasing yields and building resilience against climate shocks. However, their adoption remains limited, partly due to affordability challenges and farmers' exposure to downside risk. This study examines how upfront costs and index-based insurance influence the adoption of drought-tolerant maize seeds among smallholder farmers in Northern Ghana. Through a framed experiment, we assess farmers' decisions when choosing between traditional and drought-tolerant seeds under two conditions: a) the effect of upfront costs, and b) the role of insurance in mitigating downside risk. We compare three insurance structures—unconditional coverage, conditional coverage (tied to improved seed adoption), and group-based risk-sharing—to evaluate their impact on adoption rates. Preliminary findings indicate that upfront costs do not significantly deter adoption, but conditional insurance significantly increases uptake. Additionally, group-based risk-sharing mechanisms may enhance the appeal of insurance. These insights contribute to the discourse on financial instruments for sustainable intensification and highlight policy-relevant strategies to improve agricultural resilience in the face of climate variability.

### **Creating the Right Linkages between Farmers and Supply Chain Actors in Ghana: Evidence from Northern Ghana**

*Ferdinand Tornyiye, Selorm Ayeduvor (selormayeduvor@gmail.com), Maria-Ancilla Bombande, Fatima Denton*

The food supply chain is essential for food security and reducing poverty in Ghana, especially in the Northern Region, where smallholder farmers lead agricultural production. However, weak connections between farmers

and other parts of the supply chain limit productivity and market access. This study uses a SWOT analysis to look at the strengths, weaknesses, opportunities, and threats within the supply chain, highlighting key gaps and ways to improve it. Strengths include a good awareness of sustainable practices, available extension services, and strong government support for agriculture. However, weaknesses such as dependence on imported fertilizers and seeds, underdeveloped local processing industries, and limited machinery present significant challenges. There are opportunities to use ICT tools, collaboration with research institutions, and strengthening farmer cooperatives to improve access to inputs and markets. The threats includes climate change, insecure land rights, social norms that restrict new technology use, and poor infrastructure that limits market access. To make supply chains more efficient, the study suggests several recommendations. These include creating digital platforms for farmers to access inputs more readily, financing for agricultural value chains to improve credit access, and forming farmer cooperatives to access machinery. This involves prioritizing the need for better processing facilities at the local level. Improving market connections through systems that allow for warehouse receipts and buffer stock programs can help ensure stable prices and lower post-harvest losses. By implementing these recommendations, we can build stronger and more sustainable supply chains that support inclusive agricultural growth in Northern Ghana.

### **How can Insurance, often cited as a tool for risk management, also become a catalyst for sustainable agricultural practices?**

*Linda Busienei (lbusienei@acreafrica.com), Lilian Waithaka (lwaithaka@acreafrica.com)*

Agricultural insurance is widely recognized as a critical risk management tool, offering financial protection against climate shocks, pests, and other uncertainties. However, its role extends beyond compensation for losses—it can actively promote sustainable agricultural practices. By linking insurance coverage to ISFM practices, such as minimum tillage and drought tolerant seeds, insurance providers can incentivize long-term resilience among farmers.

Innovative models, such as index-based insurance, enable premium discounts and payout structures that reward the adoption of sustainable farming methods. Bundled insurance solutions integrate advisory services, drought tolerant inputs, and access to finance, creating a comprehensive support system that encourages environmentally responsible agriculture. This holistic approach not only strengthens farmers' resilience to climate change but also improves productivity and food security. Agricultural insurance de-risks investments in sustainable innovations, making it easier for farmers to access credit and adopt regenerative practices like agroforestry and efficient irrigation. By shifting from a reactive risk-mitigation tool to a proactive driver of sustainability, insurance can catalyze a transition toward climate-resilient farming systems. This paper explores how insurance can be leveraged to transform agriculture into a more sustainable, resilient, and profitable sector while ensuring long-term environmental and economic stability.

### **Regional scale biophysical assessment of potential for sustainable intensification**

*Madina Diancoumba (madina.diancoumba@zalf.de)*

Smallholder farmers in sub-Saharan Africa (SSA) rely heavily on rain-fed agriculture, making them particularly vulnerable to food insecurity. Climate change is expected to disrupt traditional weather patterns, potentially introducing unprecedented climatic conditions in the region (Thornton et al., 2011). This is further compounded by rapid population growth, which drives increasing food demand. As a result, enhancing agricultural productivity while preserving natural resources is critical, especially in developing countries where land degradation remains a major threat to food production. Sustainable intensification (SI) offers a viable solution by increasing agricultural output while reducing environmental impacts and improving resource-use efficiency (Mouratiadou et al., 2020). However, the potential for SI in northern Ghana remains largely unexplored. This study aims to: i) delineate homogeneous production units (PUs) based on biophysical similarity, and i) Match SI practices to suitable bio-socio-economic environments. To achieve this, we will perform a clustering analysis to identify production units with shared biophysical characteristics. The SIMPLACE crop model will be used to evaluate different Integrated Soil Fertility Management (ISFM) options, including inorganic and organic fertilizer applications in sole and rotational cropping systems. Key sustainability indicators will be employed to assess the viability of each practice. Additionally, large-ensemble climate datasets will enable a robust risk assessment, ensuring that climate variability is accounted for. Finally, key indicators will be integrated with socio-economic data to assess the feasibility of proposed interventions. This approach aims to minimize climate risks while enhancing food security at the regional scale.

## ICT & Machine Learning (Chair: Pilo Mikémina)

### Automation of Rangeland vegetation scoring using machine learning techniques

*Zakieh Alizadeh (zakieh.alizadehsani@uni-kassel.de), Abozar Nasirahmadi*

Vegetation in African rangelands is characterised by high diversity and temporal and spatial heterogeneity. Pastoral livestock keepers regularly assess rangeland conditions, particularly before taking decisions on moving their herds. This work aims to present a machine learning-based approach as an automated assistant for rangeland scoring using local knowledge. To this end, this project combined field data and public datasets to train a machine-learning model for rangeland scoring based on visual vegetation data. The data collection is enhanced by a mobile app that facilitates image pre-labeling by herders. Afterward, labeled images feed an ML-based learning model which is responsible for assigning labels to unseen images. The initial result demonstrates significant class diversity and imbalanced data. Although machine learning techniques were able to partially address these issues, due to the natural imbalance distribution of vegetation and study site accessibility the focus was placed on the most common and dominant plants. The obtained results, demonstrate that computer vision techniques combined with enhanced preprocessing based on visual data characteristics and metadata from community knowledge, can provide a promising automated rangeland scoring system.

### Application of artificial intelligence and satellite imagery to support pastoralists for Rangeland management

*Sebastian Schmidt (sebastian.schmidt@uni-kassel.de), Hooman Hosseini (hooman.hosseini@uni-kassel.de), Abozar Nasirahmadi*

Rangelands are characterised by irregular and highly distributed rainfall; at the same time, they offer many natural resources and provide the basis for extensive livestock keeping, which supports more than 60 million people in sub-Saharan Africa. For sustainable pasture management, information on the qualitative and quantitative status of the vegetation is essential; collecting this information is time-consuming and labour-intensive. Remote sensing in combination with deep learning methods can be used to provide pastoralists with additional regularly updated information on the state of the vegetation in the rangelands. In this study, different machine learning and deep learning algorithms are combined to classify vegetation types, including trees, shrubs, grass, and bare soil. Furthermore a comparatively small training dataset by semi-supervised learning is used to finally train a deep learning model which is then regularly applied to the current satellite images and should provide a classification of the vegetation. The results are checked and validated in the training phase using geotagged images. These images are taken by pastoralists using an app that is already ready for use. In addition to spatial information, these images also contain information about the condition or usability of the vegetation in the form of an assessment by the pastoralist taking the image. The resulting rangeland assessment are integrated as maps in a rangeland app and thus made available to pastoralists to contribute to sustainable rangeland management.

### Co-Creating Connections: A Mobile Solution for Veterinary Services and Peer Exchanges

*Derrick Noah Sentamu (sentsderrick@gmail.com), Joshua Onono, Raphael Lotira Arasio*

Livestock diseases are a major constraint to livestock production. Their impacts are amplified in pastoral communities due to marginalization, high herd mobility in highly variable environments, porous borders and poor animal health delivery systems among others. Livestock disease surveillance is critical in detection, sharing information and subsequent response. Pastoral disease surveillance studies show that community stakeholders are heavily involved in the activity, with intricate connections involving exchanging information and services. It's also widely accepted that engaging beneficiaries in intervention development is essential in producing an adoptable and efficient intervention with high community ownership. The presentation gives results on co designing an online platform for disease reporting and response with pastoralists and members of private and governmental veterinary service. The ongoing study is carried out in twelve study sites distributed over Laisamis and Sololo constituencies in Marsabit County in Kenya. The inclusive co – design

approach considers capacities also of illiterate pastoralists Various steps were taken to design functionalities and user interface properties based on pastoralists' preferences

### **From Local Wisdom to Digital Solutions: Enhancing Veterinary Services in Namibia**

*Colin Stanley (cstanley@nust.na), Steven Tjiraso, Eliazer Mbaeva*

Livestock farmers in rangeland communal areas have relied on local wisdom for centuries to manage animal health, particularly where access to costly livestock medication is limited. This Indigenous Knowledge (IK) enables farmers to diagnose and treat their animals, sustaining their livelihoods. However, this invaluable knowledge is often excluded from emerging artificial intelligence (AI) applications for animal health. The lack of integration of IK, coupled with the complexity and uncertainty of livestock health data, creates significant challenges in effectively diagnosing and treating diseases.

This study explores the integration of local wisdom with scientific knowledge to create a comprehensive framework for animal health management. An ontological approach is used to synthesize local expertise, enabling its representation in co-designed, user-friendly applications.

Employing action research and an Afrocentric community-based co-design approach, we found that animal health information exchange is shifting from oral methods, such as radio, to more visual forms on social media. However, no coordinated systems or applications currently exist to streamline this process.

To address this gap, we propose a context-sensitive intuitionistic fuzzy logic-based AI model that integrates scientific and indigenous veterinary knowledge. This model aims to enhance livestock disease diagnosis in underserved communities in Namibia's Kavango East and Omaheke regions.

### **Building Bridges: Local Community Networks for Climate Change Resilience**

*Seti A. Afanou (seticoco@gmail.com), Ousia A. Foli-Bebe (ousiafb@gmail.com), Friederike Fröbel (friederike.froebel@dfki.de), Victoire E. Tsamedi (yaeyram@gmail.com)*

Local Community Networks (LCNs) offer a cost-effective and robust solution to provide internet access in remote areas lacking comprehensive infrastructure. By enabling access to knowledge, facilitating communication, and leveraging machine learning applications such as predictive modeling, image analysis, and language assistants, LCNs can significantly improve agricultural resilience in Sub-Saharan Africa. This empowers farmers to overcome challenges such as climate change and improve agricultural productivity.

## **Walk through poster exhibition (Chair: Hannah Jaenicke)**

### **Diet Quality and Food Security Pattern among Fulani Households in Northern Benin: A longitudinal survey using pictograms**

*Mahounakpon Wilfried Tossou (Wilfriedtossou581@gmail.com)*

Nutrition is both a driver and an indicator of development. Good nutrition delivers widespread benefits from households to entire nations, while malnutrition undermines progress and exposes the health and well-being of present and future generations. The Fulani, one of the largest pastoralist groups in West Africa, are often excluded from food and nutrition surveys due to their predominantly nomadic lifestyle, which involves moving with their cattle in search of pastures. However, climate change, resource depletion, and restrictions on traditional grazing lands have prompted many Fulani communities to adopt more sedentary lifestyles. This study employs a longitudinal food survey with a pictogram-based questionnaire to analyse seasonal variations in food consumption, dietary diversity, and the contribution of animal-source foods, particularly dairy, to the diets of these households. The study provides novel insights into the food security and dietary quality of Fulani communities. The use of colourful, pictorial format of the questionnaire enhanced households' engagement. Results revealed general good dietary diversity and food consumption scores, though both location and seasonality significantly influenced these outcomes.

## **Characterization of shea tree and maize agroforestry parklands in northern Benin**

*Houeto Geronime Marlene Mondoukpe (houeto.g@wascal.org)*

Maize (*Zea mays* L.) contributes significantly to food security and poverty reduction in northern Benin where it is traditionally grown within selectively thinned naturally regenerated shea trees (*Vitellaria paradoxa* C.F. Gaertn). These shea-maize parklands promote a biodiverse landuse. Recent policies aiming at the intensification of these systems have been largely unsuccessful. This is largely because they are heterogeneous in their management, tree structure and composition. Hence this study aimed at classifying them into groups. To this end a survey was used to collect socioeconomic and farm management information from 70 randomly selected farmers in Boukoussera and Wewe. Additionally farm assessments were undertaken to obtain information on tree density and richness and maize grain yield. Principal component analysis and hierarchical clustering were used to define three distinctive groups. Although tree species richness of Group 3 parklands was 40% higher than of parklands in group 1 and 2, this difference was not statistically significant. Average tree density of parklands in Groups 1 and 2 was 2.5-times lower ( $p < 0.01$ ) than average tree density of Group 3 parklands. Type 1 parklands benefitted from seven-fold higher ( $p < 0.01$ ) application of inorganic fertilizers than in Groups 2 and 3 parklands. As a result, average maize grain yield in Groups 2 and 3 parklands was 26% lower than that of Group 1 parklands. The amount of herbicide used in Group 2 parklands was five-times greater than in Group 1 parklands. Our study strongly suggests that interventions to improve shea-maize parklands in northern Benin should be tailored to location specific characteristics.

## **Assessing the effect of mineral fertilizer microdosing and shade on yield and economics of maize in shea parkland systems of West Africa**

*Houeto Geronime Marlene Mondoukpe (houeto.g@wascal.org)*

Soil fertility management through the application of inorganic fertilizer is critical for sustainable maize production in Sub Saharan Africa. Fertilizer microdosing has been demonstrated to increase maize yield in monoculture. This study aimed to assess the effect of microdosing on maize yield in *Vitellaria paradoxa* C.F. Gaertn. parklands in Northern Benin and in the Savannah Region of Ghana. To this end four isolated *V. paradoxa* trees were selected in farmer fields whereby each area of tree influence was delineated into canopy area (Zone A), 3 m away from canopy (Zone B), 10 m away from canopy (Zone C), and 20 m away from canopy (Zone D). In each zone, three fertilizer application treatments were implemented on maize. These were (i) farmers' practice without fertilizer application (FP), (ii) microdosing (MD) application of 1.5 g at planting, and (iii) national recommended (NPK) application rate 3.2g of NPK. For grain yield there was a significant interaction between Zone and fertilizer application whereby grain yield of NPK at Zone D was 2.5-times higher ( $p < 0.5$ ) than grain yield of FP in Zone A. Average stover yield of NPK and MD was 31% lower than stover yield of FP. We conclude that in agroforestry parklands, maize fertilized with MD can produce yields comparable to the much higher recommended application rate.

## **Zinc and boron application in agroforestry parklands: Impacts on maize yields in northern Ghana and Benin**

*Amisu Mohammed (mohammedamisu@gmail.com)*

Maize (*Zea mays* L.) is a major cereal crop that is extensively produced and consumed in Sub Saharan Africa (SSA) (Liu et al., 2020; Cudjoe et al., 2021). It is estimated that more than 100 g of maize is consumed per day in most of the countries in SSA (Cairns et al., 2021). Despite its importance, current yields of maize (2 t/ha) are five times less than the achievable yield as a result of climate and soil prevailing in these regions (Guilpart et al., 2017).

Smallholder farmers widely use nitrogen (N), phosphorus (P) and potassium (K) fertilizers for maize production in northern Ghana and Benin. Several studies have shown positive response of maize yields to NPK fertilizers. However, NPK fertilizer-induced yield increases appears to have plateaued, making it necessary to reevaluate other soil nutrients for their potential to boost crop yield.

Shea tree (*Vitellaria paradoxa* C. F. Gaertn) parklands are the dominant land use system in northern Ghana and Benin. Given paucity of information on NPK and micronutrient effect on maize agronomic performance in these parklands. This study was conducted to evaluate the effect of Zn and B on maize grain yield in a typical open parkland system dominated by shea trees (*Vitellaria paradoxa* C. F. Gaertn)

## **Incentive Systems for Sustainable Land Management: Lessons from Northern Ghana**

*Alex Aboagye Bampoh (aabampoh@yahoo.com)*

In Ghana, land degradation is a critical issue with significant agricultural implications. Various solutions have been proposed to combat the growing trend of land degradation. This study examines incentives used to encourage the adoption of sustainable practices aimed at reversing land degradation. The extent to which these incentives have achieved their goals, as well as the policies and institutions that shape access to and equity in incentive distribution, will be examined. The agency and behavior change in agri-food systems (ACT) framework will be employed in the study. The study will adopt a mixed-methods approach, utilizing surveys, in-depth and key informant interviews, qualitative document analysis and focus group discussions to gather data from key stakeholders (e.g., farmers, local leaders, government officials, NGOs, research and academia). The research will provide empirical insights into incentive systems in a complex and challenging setting. It will offer recommendations for enhancing the adoption of sustainable land management practices in Northern Ghana and similar regions. The emphasis will be on practical and effective incentive systems that benefit farmers, communities, and agroecosystems.

## **Understanding land use/land cover change and climate interactions: A review**

*Audrey Kantz Dossou Codjia (codjia.k@wascal.org)*

Land use and land cover change (LULCC) significantly impacts the earth's climate and ecosystems, affecting sustainable land management (SLM). This review explores the complex relationships between LULCC and climate change, focusing on advanced methods for monitoring, modeling, and predicting LULCC, as well as innovative approaches to analyzing climate dynamics. It highlights recent advances in geospatial technologies, artificial intelligence, and integrative frameworks that address human-environment interactions. Despite technological progress, challenges such as data gaps, spatial-temporal mismatches, and limited interdisciplinary models persist. This review focuses on research conducted from 2020-2024, showing how LULCC drives climate change and vice versa. It demonstrates how this knowledge can improve sustainable land use, support agriculture, protect the environment, and help communities adapt to climate change. By presenting the latest tools and approaches, this review aims to assist researchers and policymakers in developing nature-based solutions for land management and climate challenges.

## **Assessment of dominant herbaceous species and aboveground biomass production in northern Benin's communal grazing lands**

*Sèwanou Frimence Allogbènou Tossou (frimencetossou@gmail.com), Rodrigue V. Cao Diogo, Eva Schlecht*

The study focuses on assessing dominant herbaceous species and their aboveground biomass production in the communal rangelands of northern Benin during the rainy season. Specifically, the aim was to identify the dominant herbaceous species on the natural rangelands, quantify the aboveground biomass of herbaceous plants and determine the implications of biomass production for the sustainability of natural resources grazing. Three of the herbaceous with the highest covering percentage were recorded and identified and the aboveground biomass was determined using destructive sampling. *Grona trifloral* (L.) H. Ohashi & K. Ohashi, *Digitaria sanguinalis* (L.) Scop. and *Mesosphaerum suavelens* (L.) Kuntze were identified as the three most dominant species found on the grazing lands of the study. The highest biomass production was recorded during the middle of the rainy season with values of  $946.56 \pm 450.26$  Kg.MS/ha against  $668.64 \pm 455.65$  Kg.MS/ha recorded early in the rainy season. By monitoring and analyzing these factors, the study seeks to provide insights into maintaining the productivity and biodiversity of these ecosystems, ensuring the long-term sustainability of livestock-based livelihoods in northern Benin.

## **Pastoral women's information needs and gaps related to livestock production and marketing: Insight from Northern Kenya**

*Keerthana Sri (k.sri@ditsl.org), Maria Jose Restrepo (m.restrepo@ditsl.org), Margareta Lelea, Brigitte Kaufmann*

Pastoralists have long adapted to the spatial and temporal variability of rangeland resources through mobility and extensive local knowledge, significantly contributing to agricultural production and food security. In Kenya, the pastoral sector has an estimated annual market value of €50–80 million. Despite these contributions,

mobile livestock keepers are often marginalized in policy and practice—a disparity that is further exacerbated for female livestock keepers.

This study examines the roles and contributions of women within the Rendille and Borana pastoral communities in Northern Kenya. Data was collected using qualitative and participatory research methods. Findings highlight the diverse tasks undertaken by women, including collecting fodder and firewood, caring for pregnant animals and their offspring, assisting with livestock during relocation, and tending to animals left at the homestead.

Women’s critical expertise lies in milk handling, resolving milking challenges, and providing essential care for sick animals. However, they face significant barriers to market participation due to asymmetric information and trust issues with market actors. Furthermore, limited access to training in milk processing, preservation, value addition, and livestock disease diagnosis exacerbates these challenges. This study highlights the urgent need for targeted, gender-sensitive interventions to bridge knowledge and information gaps. Ensuring equitable access to training and information can empower women, strengthen resilience, and support sustainable development in pastoral communities.

### **Influence of Cow Breed and Location on Milk Quality Properties and West African Soft Cheese Yield**

*Matthew Atongbiik Achaglinkame, Linda Dari, Daniel Mörlein*

The role of milk and milk products in sustaining livelihoods and improving food security cannot be over-emphasized. This study explored the impact of cow breed and farm location on milk quality and indigenous cheese (“Wagashi”) yield. Two samples (three litres) of fresh milk per breed were collected from four main breeds at two different locations in Ghana. The milk samples were analysed in triplicate for fat, protein, lactose, total solids and density using an SP lactoscan milk analyser (SP-013556). Subsequently, the milk was processed into “Wagashi” using *Calotropis procera* leaves for coagulation at 80 °C. The data obtained were statistically analysed for their means and standard deviations. The findings will be presented at the status seminar if considered.

### **Food consumption and household dietary diversity patterns among herder households in the West Gonja Municipality of Ghana**

*Matthew Atongbiik Achaglinkame (machaglinkame@uds.edu.gh), Linda Dari, Daniel Mörlein*

This study investigated dietary diversity and food consumption among herder households (n = 98), at three different times in 2024, in five communities in the West Gonja Municipality of the Savanna Region of northern Ghana. These communities were purposively selected because of the large presence of cattle herds due to the vast available grazing fields. The study employed pictogram-based questionnaires and standard procedures to identify the diverse food groups consumed by more than 50% of the households daily for two continuous weeks to have a clear picture of their food consumption patterns (household dietary diversity scores (HDDS) and (household food consumption scores (HFCS)). The HDDS and FCS values were computed and analyzed, and the means and standard deviations were reported to evaluate the food security indicators of the respondents according to communities and time of the year the data were collected. I therefore wish to share my findings at the status seminar.

### **E-Learning Certificate on Research & Innovation on SLM in Africa**

*Silvia Berenice Fischer (silviaberenicefischer@h-brs.de)*

We aim to showcase the development process of the E-Learning Certificate and the collaboration with our colleagues from WASCAL (COINS & DECLARE), UESD, and FARA. Additionally, we will provide a brief introduction to the E-Learning certificate.

## **Interactive Insights: Access to climate change adaptation knowledge via Local Community Networks (hands-on exhibit)**

*Ousia A. Foli-Bebe, Carina Lange, Friederike Fröbel (friederike.froebel@dfki.de), Seti A. Afanou, Victoire E. Tsamedi*

This DIY Raspberry-Pi-based Local Community Network (LCN) provides a platform for the exchange of knowledge about the impact of climate change for subsistence farmers in Togo. Connect your smartphone and engage with this peer-to-peer knowledge transfer. Through this format, we facilitate the co-creation of knowledge modules in different media formats on topics such as reaction to the increase in extreme weather events, pests and desertification, and potential actionable solutions.

## **The DecLaRe decision support tool box in practice (hands-on exhibit)**

*Karsten Vennemann (karsten@terragis.net)*

As part of the DecLaRe project, a digital toolbox—also referred to as a decision support system (DSS)—was developed to support land use planning and the identification of suitable intervention areas for agricultural innovations. The toolbox integrates openly available maps, satellite imagery, and research datasets with a focus on soils and climate.

Developed entirely with open-source software, the toolbox is flexible and can be adapted for use in other regions. It includes three core tools:

- Land Evaluation Tool – Based on the FAO framework (Sys et al. 1991), this tool combines crop, soil, and climate data to generate biophysical suitability scores, supporting agricultural planning and ex-ante evaluation of innovations.
- Micro-Dosing Tool – Allows spatial assessment of site-specific fertilizer application (small doses per plant), tailored especially for smallholder farmers with limited resources.
- Micronutrient Chain Tool – Identifies potential regions with human micro-nutrient deficiencies by linking natural soil and geological conditions to nutrient availability across the food chain.

Overall, the DecLaRe Toolbox promotes sustainable, data-driven agricultural decision-making.

## **Governance of land and natural resources (Chair: Oliver V. Wasonga)**

### **Understanding the Governance Structures of Rangeland Management: Insights from Namibia's Agropastoralist Communities**

*Andreas Erastus (andreasvalde03@gmail.com), Hilma Amwele, Lilli Scheiterle, Brigitte Kaufmann*

In Namibia, approximately 78% of the country's arid to semi-arid land is used for livestock production, with about half designated for communal grazing. Communal land supports around 70% of the population, who primarily rely on livestock farming and, in some regions, rainfed crop production. Over generations, rangeland governance systems have evolved, shaped by societal transformations and shifts in legal and policy frameworks. While traditionally managed by smallholder agro-pastoral communities, conservancies and their management committees have recently emerged as key actors in governing communal land. This study explores both customary and introduced governance systems within conservancies to assess their functionality and how they are influenced by environmental and social changes. The research, conducted in the Kavango East and Omaheke regions, employs participatory mapping, net mapping, focus group discussions, and key stakeholder interviews. Findings reveal that livestock husbandry on communal land is organized around settlements, with grazing areas delineated by defined uses and characteristics that influence their management. Herders' decision-making regarding grazing management is shaped by environmental conditions, resource availability, and socio-cultural norms. These findings underscore the complex interplay between governance systems and the evolving environmental and social contexts.

## **How Herders observe the range conditions to inform decision making**

*Akala Haron (akalaharon3@gmail.com), Oliver V. Wasonga, Maria J. Restrepo, Raphael Lotira Arasio, Brigitte Kaufmann*

Pastoralist communities hold critical ecological knowledge that is essential for sustainable rangeland management, but their insights are usually not available to other external stakeholders involved in rangeland management in the areas concerned. This study was conducted in the northern rangelands of Kenya with pastoralist communities in Marsabit County. In this study, knowledge was co-created through participatory approaches to map rangeland units and identify key indicators for their categorisation. The presentation provides insights into the use of participatory photography and photo elicitation to elicit how pastoralists monitor the condition of the rangelands. The results showed that grazing units are demarcated mainly on the basis of ecological attributes that determine suitability for livestock species and define the season of use. Our findings reveal indicators and thresholds used by pastoralists to monitor rangeland conditions. Pastoralists' knowledge of the spatial and seasonal availability of resources is crucial in guiding decisions on rangeland use and resource monitoring.

## **Land Reform in Benin: Examining the Potential Impacts on Vulnerable Populations through the Lens of Fulani Sedentarization**

*Eunice Adwoa Sarpong (eadwoasarpong@gmail.com), Nikolaus Schareika, Georges Djohy*

Benin's land reform presents a crucial opportunity to enhance land tenure security, particularly for marginalized and vulnerable groups. However, successful implementation requires significant institutional changes and careful consideration of the diverse needs of stakeholders. This study examines the sedentarization of Fulani communities in Northern Benin as a case study to inform ongoing land reform implementation and their potential impacts on vulnerable populations such as Fulanis, women, and youth. Through video documentation, we capture conversations and observe adaptation strategies related to land use practices, negotiations, and conflict resolution mechanisms employed by Fulani communities. Furthermore, this study evaluates these strategies for their effectiveness in promoting sustainable land management and building resilience. Analyzing the sedentarization policy and its outcomes provides valuable insights into the potential implications of fully implemented land reforms for vulnerable populations. This approach allows for a critical examination of current practices and their effectiveness in securing land rights, ultimately contributing to a more comprehensive understanding of the impact of land reform on vulnerable populations in West Africa.

## **Land Tenure, Climate Adaptation Strategies, Agricultural Productivity, and Food Security Nexus in Northern Ghana**

*Abraham Zakaria (zackabram@yahoo.com), Seidu Al-hassan, Kati Krähnert*

Studies on land tenure security and land rights effects on climate adaptation strategies are limited in the literature. This study assesses the land tenure security and land rights status and their effects on climate adaptation strategies, using 2934 rural farm households in Ghana. The study revealed that about 32% of farm households' farmlands are insecure. About 44%, 73%, and 81% of households with secure farm plots have land usability, transferability, and exclusivity rights respectively. Land rights have a significant correlation with land tenure security. Similarly, land tenure security has a positive and significant effect on six climate adaptation strategies but a negative effect on two adaptation strategies. This implies an increase in household tenure security rights over farmland will increase households' propensity to invest in climate adaptation strategies. Enhancing land tenure security and land property rights is a pathway to inspire farmers to invest in agriculture to combat climate change's impacts on livelihoods and food insecurity. Hence, policies should focus on strategies to enhance farm households' land tenure security rights, and this can involve legal recognition of land ownership under the customary land tenure systems which can enhance tenure security.

## **Beneath the Surface of Rangeland Governance: Examining Values, Norms, and Practices in Northern Kenya's Pastoralist Communities'**

*Malit Wako (wmaliti@gmail.com), Lilli Scheiterle, Hussein Wario, Brigitte Kaufmann*

The governance of the communal rangeland resources in Kenya is guided by legal and customary rules. Community governance regulates access to and use of pasture and water resources. However, in some areas this has weakened due to a lack of recognition in government. To understand the current state of rangeland governance, this presentation explores the values, norms, and practices underlying resource use among the Borana and Rendille communities in Marsabit County, employing a mixed-method approach that includes net-mapping, activity knowledge analysis, focus groups discussions, and key informant interviews conducted over twelve months. The findings will be illustrated using the example of water resource governance across different seasons. During periods of resource scarcity, existing rules and norms gain heightened significance, both in their observance and enforcement. Stakeholders must engage in active communication to equitably distribute available resources. Decision-making requires careful consideration of multiple factors, such as the needs of livestock, distances to be traveled, and the availability of water sources. This process demands a deep understanding of herd requirements and environmental conditions, rooted in long-standing norms and practices that have guided resource use over time. Recognizing embedded local governance structures, policymakers can better align reforms with pastoralist realities, fostering equitable and sustainable outcomes.

## **Ruminant keeping and feed resource availability: A case study in Northern Ghana**

*Elizabeth Yeboah (eylizzy2015@gmail.com)*

Mixed crop-ruminant (MCR) farming is a major source of livelihood for most people in sub-Saharan Africa, yet it is practiced extensively. MCR farmers face challenges such as feed scarcity, which results in low production due to seasonality and rapid land use for cropping.

This study intends to identify and evaluate the available feed resources, current feeding practices, herd management, land use, and challenges faced by MCR farmers in the Northern and Savannah regions, respectively. It will also assess the nutritional values of the feed resources according to seasons and regions and, finally, estimate the yield of feed resources according to seasons and regions.

A statistical analysis will be performed using R software. Then, a proximate composition analysis (DM, OM, CP, NDF, ADF) of the feed resources will be determined using the standard procedures of the Association of German Agricultural Analytic and Research Institutes (VDLUFA 2012).

At the end of the study, we hope to evaluate whether current feeding practices and management are sustainable and, if not, what alternative can be provided to intensify production of the MCR farmers in the Savannah and Northern regions, respectively.

## **Building Bridges: Land governance for sustainable management of natural resources**

*Pilo Mikémina (pilomikemina15@gmail.com), Kolani Lardja (laldagoukolani@gmail.com)*

We analyse in this research the influence of land governance on sustainable natural resources management with a particular focus on the effect of land tenure security on the adoption of sustainable land management practices by Togolese agricultural households. To achieve this, we use the propensity score matching (PSM) method and the IPWRA method applied to data from the 2021 Harmonized Household Living Conditions Survey (EHCVM) collected from 2,900 agricultural households. The results show that households that enjoy permanent land rights to their farmed plots are more likely to adopt sustainable land management practices than households that do not. Thus, the move towards sustainable management of natural resources such as land is highly dependent on the governance model. Encouraging agricultural households to adopt sustainable land management practices involves strengthening their sense of security regarding their farmland. This can be achieved through land certification campaigns.

## Pathways to Impact (Chair: Emmanuel Theodore Asimeng)

### **A retrospective study of agricultural innovations development and adoption in Northern Benin using the “Follow the Innovation” method**

*Emmanuel Theodore Asimeng (theodore.asimeng@idos-research.de), Michael Brüntrup*

Advances in agricultural development have largely been driven by the adoption of innovations aimed at improving productivity, resilience, quality and other key objectives from farmers and food systems actors, including processors and consumers. However, smallholder farmers in Africa adopt these innovations at significantly lower rates than farmers in other regions, impacting their livelihoods, communities and the environment. Follow the Innovation (FTI) is a method designed to support the innovation development process, focusing on achieving adoption by the intended users. In northern Benin where a number of innovations have taken place, FTI was used to retrospectively analyse and document the factors influencing the adoption of agricultural innovations among smallholder farmers and other stakeholders. This poster presents the study's findings and insights.

### **Holistic Decision Modeling for Sustainable Land Management: A Case Study in Northern Ghana**

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The impacts of sustainable land management practices are usually assessed with linear and precise models. Such models fail to account for the full complexity of agricultural systems. To address this, we use holistic decision modeling approaches, which express all relevant factors—whether derived from data, literature, or expert knowledge—in a probabilistic framework. For Northern Ghana, we developed quantitative models for Integrated Soil Fertility Management and fertilizer microdosing. These models consider a comprehensive range of risks, benefits, and costs based on the current state of knowledge, rather than relying solely on precise estimates. Through participatory methods, we co-created impact pathways with local stakeholders and translated them into simulation models. These models forecast long-term outcomes, identify critical knowledge gaps, and highlight key risks, providing robust guidance for scaling these innovations under real-world uncertainties.

### **Key policy recommendations from a dialogue on transdisciplinary research funding for sustainable development in Africa**

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As part of the INTERFACES project a dialogue on "Good practices in transdisciplinary research funding for sustainable development in Africa" has been organized. Key policy recommendations for German funders resulting from the dialogue are summarized in a policy brief.

### **How modeling can assist adaptation planning: Insights from crop modeling and mental models**

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Effective adaptation planning under climate change requires integrating both scientific modeling and mental models—the cognitive frameworks that shape decision-making. Crop modeling approaches, such as EcoCrop and APSIM, offer quantitative insights into crop suitability and yield under current and future climate scenarios, helping identify resilient crop options that enhance agricultural sustainability. These models provide an evidence-based foundation for adaptation by simulating potential shifts in crop viability, guiding land-use strategies, and supporting biodiversity conservation. However, the effectiveness of these models depends on how farmers, policymakers, and stakeholders perceive and interpret the information—shaped by their mental models. Understanding these cognitive frameworks is essential for bridging the gap between scientific outputs and real-world decision-making. This session explores how different modeling approaches can improve adaptation strategies, especially for crop diversification, in West Africa by aligning research findings with stakeholder perceptions, fostering knowledge co-production, and enhancing decision-making in agricultural planning.

## Exploring gender dynamics and intersectionality in sustainable land systems (Chair: Tina Beuchelt & Constance Akurugu)

### Gendered impacts of climate change in agricultural communities in Northern Ghana: an intersectional perspective

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In the past, research on climate change impacts and adaptation pathways in agriculture have largely overlooked gender issues. Although this is gradually changing, many impact studies still fail to consider intersectional aspects, gendered roles in farming, and differentiated access to and control over resources and agricultural production means. This study aims to identify the gendered impacts of climate change in agriculture from an intersectional perspective in Northern Ghana. We conducted qualitative key person and in-depth interviews with 25 farmers and gender experts. Access to land and farming resources varies across the region and between polygamous and monogamous households. Additionally, the order of marriage and having children in polygamous households plays a significant role. Women are expected to contribute to household income through their own farming activities, yet they are not recognized as farmers in their own right. All respondents reported experiencing the impacts of climate change, with 2024 being marked by a severe drought. Increasing pressure on land due to urbanization, declining soil fertility, and climate change, coupled with decreasing household incomes, exacerbates the precarious situation of women. Off-farm income sources that can buffer against irregular weather conditions are urgently needed.

### Gendered power dynamics and farmers' decision-making in sustainable farm management in Northern Ghana

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A myriad of challenges ranging from land pressure and poor infrastructure to low soil fertility and high dependence on rainfed agriculture negatively affect smallholder farmers' livelihood. These challenges have been exacerbated by the effects of climate change. Sustainable agricultural practices (SAPs) are promising farming practices that can potentially increase agricultural productivity and adaptation to climate change. However, in Northern Ghana, the positive impacts of SAPs are highly dependent on farmers' adaptive capacity and their decision-making power. Those are highly influenced by entrenched social and cultural expectations shaping men and women farmers' access to resources, time burden and household dynamics. Hence, this study uncovers the power dynamics within the household, shaped by local gender norms, influencing decision-making in sustainable farm management under climate change. This research is based on qualitative methods, with data collected through Photovoice and 8 Focus Group Discussions. The results highlight the unbalanced decision-making power between men and women farmers when it comes to adopting sustainable agricultural practices. Those disparities are rooted in the social, religious and cultural norms of the patriarchal system of northern Ghana, as well as the power dynamics within the household, one of which is gender-based violence.

### Gender Norms in Land Tenure and Sustainable Land Management in Northern Ghana

*Irene Ampaabeng (irene.ampaabeng@stu.ucc.edu.gh), Akua Britwum, Tina Beuchelt*

Unequal land rights for women are prevalent in jurisdictions with legal pluralism, where the intersection of customary and statutory land management systems exacerbates the disadvantaged position of women and other vulnerable groups.

As the state fails in its role of ensuring equity and social justice while communal lands become private property, women are gravely affected as their secondary land rights, derived from customary grants are being truncated as lands are sold to individuals. Consequently, gender roles are changing and women are bearing heavier burdens as livelihoods are altered and land hunger is worsened.

This study sought to investigate how pressure on land is altering customary land tenure system and to assess the extent of resultant land hunger on women's tenure making. Employing qualitative research methods such as interviews and focus group discussions, the study found that customary land tenure are fast changing as agricultural lands are being sold for non agricultural purposes and the threat of land hunger is pervasive in peri urban study areas of the Northern Region.

## **Gender Dynamics in Agricultural Innovations in sub-Saharan Africa: Evidence from a Bibliometric Study**

*Emmanuel Theodore Asimeng (theodore.asimeng@idos-research.de), Christina Meyer*

Agricultural innovations are essential for increasing productivity, enhancing resilience to climate change and ensuring food security. In sub-Saharan Africa, women constitute nearly 50% of the agricultural labour force but face significant disparities in access to land, credit, training, and agricultural inputs compared to men. However, the development and adoption of innovations often fail to account for the gender dynamics, resulting in unequal access and benefits for men and women. These inequalities not only hinder women's access and ability to adopt innovations but also limit the broader impact on household and community well-being. Recent efforts have emphasized the inclusion of women in agricultural innovation development. Understanding the gender dynamics and how knowledge about women's participation in agricultural innovation is exchanged within scientific circles is critical for addressing the gaps that still exist. Bibliometric analysis provides a valuable method for assessing the growth, trends, and gaps in research. In this study, we analysed scientific publications related to agricultural innovations and gender dynamics using platforms such as Scopus, Web of Science and PubMed. The findings offer insights into the state of research, highlights gaps and suggests directions for fostering gender-inclusive agricultural innovations.

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