# Building resilient food systems in uncertain times
# Agri4D 2023 Conference

26-28 September 2023

Agri4D siani Swedish International Agricultural Network Initiative SLU Sida

## Book of abstracts

Peter Adams/GettyImages

| Time: | Day 1 - 26 September | | | |
|---|---|---|---|---|
| 08.30 | **Conference platform opens** | | | |
| 09:00 | **Opening ceremony**<br>Welcome address – Pär Forslund, Deputy Vice-Chancellor at SLU<br>Opening address - True Schedvin, Head of Global Sustainable Economic Development, SIDA<br>Plenary keynote speaker - Dan Smith, Director of Stockholm International Peace Research Institute, SIPRI | | | |
| **09:45** | **Break** | | | |
| 10:00 | Panel 1 - Building resilient food systems in drylands | Panel 2 - Adaptation to climate change and conflict mitigation in agro-pastoralist communities | Panel 3 - Robust Governance | Panel 4 - Entrepreneur: From research to actions |
| 11:15 | Guided poster walks | | | |
| **11:45** | **Lunch break/mingle** | | | |
| 12:30 | Roundtable discussion: The UN food systems process - an agenda for action for each one of us | | | |
| **13:15** | **Break** | | | |
| 13:30 | Panel 5 - Agroecology, Food Sovereignty and Security, and Land Justice | Panel 6 - Gender-based barriers and opportunities for food security and sustainable agricultural systems | Panel 7 - Animal production, pastoral and livelihoods | Panel 8 - Gender and human rights approaches to food productions |
| **14:45** | **Break** | | | |
| 15:00 | Wrap-up of day 1 | | | |
| 15:30 | Mingle | | | |

**Please note: All time slots displayed in the conference programme are in Central European Summer Time (CEST) / UTC+2**

| Time: | Day 2 - 27 September | | | |
|---|---|---|---|---|
| 08.30 | Conference platform opens | | | |
| 09:00 | **Welcome to day 2**<br><br>**Plenary keynote speakers:**<br>Betty Kibaara, Director in the Food Initiative at The Rockefeller Foundation, Africa Region Office<br>Seema Kulkarni, National Facilitation Team member of Mahila Kisan Adhikar Manch (MAKAAM) Forum for women farmers' rights | | | |
| **09:45** | **Break** | | | |
| 10:00 | Panel 9 - A more robust food supply – research in and for uncertain times (Part 1) | Panel 10 - From project interventions to transformative impacts: Charting paths for sustained adoption of agri-food innovations | Panel 11 - Agroforestry: From Asia to Africa | Panel 12 - Indigenous knowledge production and rights in food system |
| 11:15 | Partners pitch | | | |
| **11:45** | **Lunch break/mingle** | | | |
| 12:30 | Roundtable discussion: Building the resilience of smallholder farmers through biodiversity | | | |
| **13:15** | **Break** | | | |
| 13:30 | Panel 13 - A more robust food supply – research in and for uncertain times (Part 2) | Panel 14 - Food productions and innovations | Panel 15 - Modelling, innovation and big data for sustainable food system | |
| **14:45** | **Break** | | | |
| 15:00 | Wrap-up of day 2 | | | |
| 15:30 | Mingle | | | |

**Please note: All time slots displayed in the conference programme are in Central European Summer Time (CEST) / UTC+2**

| Time: | Day 3 - 28 September | | | |
|---|---|---|---|---|
| 08.30 | Conference platform opens | | | |
| 09:00 | **Welcome to day 3**<br>**Plenary keynote speakers:**<br>Appolinaire Djikeng, Director General of the International Livestock Research Institute (ILRI)<br>Wangu Mutua, Deputy Regional Director for Vi Agroforestry | | | |
| **09:45** | **Break** | | | |
| 10:00 | Panel 16 - Unlocking the Potential of the African Continental Free Trade Area for Fostering Inclusive Development and Sustainable Food Systems | Panel 17 - Smallholders attitude toward food and agro-productions | Panel 18 - Renewable energy and supply chains | Panel 19 - Agricultural production |
| 11:15 | Guided poster walks | | | |
| **11:45** | **Lunch break/mingle** | | | |
| 12:30 | Roundtable discussion: Engaging stakeholders and translating science into policy and practice, AgriFoSe2030 | | | |
| **13:15** | **Break** | | | |
| 13:30 | Panel 20 - Food systems in the face of climate and exogenous shocks: Building back better for increased resilience | Panel 21 - Pest and sanitation | Panel 22 - Market access and supply chains | |
| **14:45** | **Break** | | | |
| 15:00 | Closing remarks and keynote speaker | | | |
| 15.30 | Wrap-up of day 3 | | | |
| 16:00 | Mingle | | | |

**Please note: All time slots displayed in the conference programme are in Central European Summer Time (CEST) / UTC+2**

## Contents

## Panel 1 - Building resilient food systems in drylands

**Building resilient food systems in drylands: Challenges and lessons learned from transdisciplinary research in East Africa**

Theme 2: Governance and rights in food systems: Leaving no one behind

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[2] Gothenburgh University
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[4] University of Nairobi
[5] Makerere University
[6] Linneaus University
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[8] IGAD

**Abstract/Session concept note text:** In this session, we will take you to the Karamoja cluster at the border of Uganda and Kenya, where pastoralists and agropastoralists communities practice livestock keeping in arid and semi-arid rangelands. Local people's livelihoods are rapidly changing due to land degradation, climate change, conflicts, and land commodification and fragmentation. Insights surrounding the Karamoja cluster will form the basis for more general discussions on resilient dryland food systems and sustainability transformations. The session is based on research carried out within the *Drylands Transform* transdisciplinary project. The format will be a mixture of video clips, testimonies from local and regional actors, short presentations by the project's students and researchers, and discussions illustrating the context, challenges and ongoing social-ecological transformations in the East African drylands.

Half of the world´s livestock population is found in drylands. In East Africa, livestock herders often use mobility to adapt to variable rainfall and fodder. Over the past 20 years, the East African drylands have experienced frequent episodes of severe drought, adversely impacting land and vegetation health, mobility, livestock and crop production, and subsequent food and nutrition security. Conflict has also had huge implications for food security. Furthermore, land tenure and governance in the area are changing fast, which is impacting (agro)pastoralists' capacity to access grazing land and practice cultivation. Alongside addressing the implications of rangeland management, land governance and conflict resolution for dryland food security, the session will discuss pathways towards more resilient food and livelihood systems.

Finally, the session will showcase 'Livestock Cafés' implemented as part of the *Drylands Transform* project. These are local knowledge-sharing hubs where researchers co-develop sustainable rangeland restoration and management options and regenerative kitchen gardens alongside local communities. They are also demonstration sites for various proven agricultural technologies and sites for the project's experimental research. By seeing, doing and learning in the 'Livestock Cafés', women, men and youth can develop new knowledge about dry season fodder production and vegetable cultivation in kitchen gardens for more

healthy and sustainable diets. Through strong collaboration with stakeholders from local to regional levels, *Drylands Transform* is influencing both policy and practice in East African drylands.

## Panel 2 - Adaptation to climate change and conflict mitigation in agro-pastoralist communities

**Adaptation to climate change and conflict mitigation in (agro-)pastoralist communities**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Marie Riquier**[1]
[1] SIPRI

**Abstract/Session concept note text:** Pastoralists and agro-pastoralists in the Horn of Africa are facing increasingly frequent and intense shocks in the form of and climate-induced environmental hazards. On one hand, conflict threatens the livelihoods of (agro-) pastoralists through violence, coerced asset stripping, etc. On the other hand, pastoral livelihoods systems are vulnerable to more frequent and intense droughts and floods. All in all, these shocks weaken the ability to cope and maintain livelihoods, leading to high levels of food insecurity in the Horn of Africa, including in Ethiopia, Somalia and South Sudan.

However, marginalized agropastoral communities experiencing limited state presence have proven resilient to shocks and stresses. Traditional knowledge in the form of pastoral risk management, conflict resolution mechanisms and sustainable management of dry land ecosystems have enabled adaptation to a changing climate and the mitigation of risks of violent conflict.

This session discusses how (agro-) pastoralist communities are mitigating conflict risks and adapting to climate change in the Horn of Africa?

First, it will explore the multiple pathways between violent conflict and climate change and food insecurity for (agro-) pastoralists. Second, it will highlight some of the traditional mechanisms adopted by these communities to manage shocks and risks. Finally, it will make a case for the inclusion of these strategies into national and regional policymaking, development plans and interventions. The inclusion of these systems is likely to foster more inclusive food systems and more adequate solutions to the threats faced by (agro-) pastoralist livelihoods and ecological systems in the Horn of Africa.

## Panel 3 - Robust Governance

**"Putting things on paper and making them work out": Exploring challenges to pesticide governance in Uganda**

Theme 2: Governance and rights in food systems: Leaving no one behind

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Ellinor Isgren[2]
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[2] Lund University, Centre for Sustainability Studies (LUCSUS) & University of Gotherburg, School of Global Studies

**Abstract/Session concept note text:** As part of ongoing efforts to 'modernise' agriculture, pesticide use is on the rapid rise in sub-Saharan Africa - a region where agrochemical use has historically been comparatively low. Along with falling global prices of generic pesticides and intensified promotion by the agroindustry, there is also a large informal market for pesticides, including banned, obsolete and counterfeit products. Despite international, regional and national policies in place which aim to reduce and regulate pesticide risks, policy enforcement has clearly not kept pace with the changing agrochemical landscape, resulting in growing concerns over the effects of pesticides on human and environmental health. Focusing on Uganda as a case, this paper aims to explore some of the key governance challenges in this rapidly growing pesticide market. Based on structured interviews with public officials, private sector representatives and civil society organization, in combination with document analysis, we investigate actors' different problem framings and views on current challenges related to pesticide regulation, monitoring and policy enforcement. Furthermore, we explore some of the opportunities for strengthening pesticide governance, including improved coordination and collaboration among actors as well as increased engagement with civil society actors.

Key words: pesticides, smallholder farming, environmental governance, discourse, sub-Saharan Africa

**Social exclusions in the fisheries governance of Morocco**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Guohan Yin**[1]
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**Abstract/Session concept note text:** With an annual production of 1.4 million tons of fish, Morocco is currently the largest seafood producer in both Arab and African countries. After the 2008 global food crisis, Morocco launched an ambitious Plan Halieutis to develop its fisheries sector in order to better profit from the value chain and achieve higher level of food security. However, the inconsistencies between different objectives and the technocratic vision behind this plan resulted in the exclusion and marginalisation of small-scale fishers whose livelihoods are based primarily on the access to fish stocks in the ocean. On the one hand, large-scale fisheries benefit greatly from government-supported projects to make the sector more "competitive". On the other hand, small-scale fishers are the utmost victims of state regulations aiming to make fishery resources more "sustainable" such as the tightening of quota and licencing rules. At the same time, they are facing challenges from foreign vessels under several fisheries partnership agreements and the enclosure of ocean space fuelled by marine aquaculture. The export-oriented nature of large-scale fisheries also compromises the Moroccan government's vision to promote food security and better nutrition with Plan Halieutis. Through a critical analysis of relevant policy documents and semi-structured interviews with social activists, my presentation aims to reveal the negative social consequences of the neoliberal, technocratic mode of fisheries development in the Global South with an example of Morocco and advocate for higher levels of stakeholder participation in the governance of the aquatic food system.

**Tackling Vulnerabilities in South Africa's Food Systems: The Need for Strong Governance**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Ntombizethu Mkhwanazi**[1]
Camilla Adelle[1], Lise Korsten[2]
[1] Department of Political Sciences, University of Pretoria, South Africa
[2] Department of Plant and Soil Sciences, University of Pretoria, South Africa

**Abstract/Session concept note text:** This abstract examines the theme of governance and rights in food systems, focusing on the South African context. It highlights the vulnerabilities faced by marginalized groups during food crises, such as foodborne outbreaks, load-shedding, and high food prices. The theme of governance and rights in food systems emphasizes the importance of inclusive and equitable access to safe and nutritious food for all individuals. It is essential to recognise that not all individuals have equal access to safe, nutritious, and culturally appropriate food. Vulnerabilities in food systems arise due to various intersectional processes and power relations that disproportionately affect specific groups of people.

In South Africa, marginalised groups are disproportionately impacted by food crises, as they face intersecting vulnerabilities rooted in historical and contemporary social, economic, and political factors. The South African food system is a complex network involving various stakeholders, including producers, distributors, retailers, and consumers. However, the prevailing governance mechanisms have proven insufficient in effectively addressing governance shortcomings in the South African food system. Hence, there is a need to emphasise the importance of robust governance mechanisms to ensure equitable distribution, sustainability, and resilience within the food system.

**Keywords**: South Africa, food systems, governance, vulnerabilities, food safety

What rural development in Mozambique? Individual land titling and the modernisation of agriculture.

Theme 2: Governance and rights in food systems: Leaving no one behind

**Margareta Espling**[1]
[1] Unit of Human Geography, Dept. of Economy and Society, University of Gothenburg

**Abstract/Session concept note text:** In 1997 Mozambique adopted a widely praised Land Law, introducing ways of formalizing customary land rights through a community-based approach to land tenure, combined with the possibility for communities to strike deals with investors for access to community land. In 2015, the Mozambican government launched an additional land initiative called *Terra Segura*, in which 5 million rural households would get their land demarcated and receive an individual DUAT - a more conventional land regularization process of individual land titling. With World Bank funding, the implementation of this initiative was speeded up.

Arguments for individual land titling are often linked to the desire for increased agricultural productivity for improved food security and for the market. The argument is that individual titles can be used as collateral for credits, to be used for investments into improved inputs and technology, and thereby modernize agricultural activities. Such arguments lie behind the 'Alliance for a Green Revolution in Africa' approach, adopted in several African countries. In Mozambique, widespread rural poverty, low agricultural productivity, and food insecurity are among the driving forces behind adopting policies for modernising the agricultural sector through its own Green Revolution policy, the Strategic Plan for Agricultural Development (PEDSA).

What future implications for rural smallholders' livelihoods and food security could be expected in the Mozambican context from the implemention of such rural and agricultural development policies? Will customary land rights and practices survive the pressure from agricultural modernisation and land commodification?

**Key words**: land titling, modernisation of agriculture, rural livelihoods, food security, Mozambique

## Panel 4 - Entrepreneur: From research to actions

**Promoting Transparency, Efficiency and Inclusive Market Systems: Experience of Tech4Ag in Piloting mDairy Innovation in Oyo State, Nigeria**

Theme 1: Securing food and nutrition within planetary boundaries

**Gbadegesin Alawode**[1]
Oyewale Abioye[1], John Adekunle[2], Mohammed Zailani[3]
[1] Tech4Ag LTD
[2] FrieslandCampina WAMCO
[3] 2Scale

**Abstract/Session concept note text:** In Nigeria, despite the impact of technology innovations in other sectors, such as health and finance, the potential of digital agriculture in the dairy sector is still less explored. Dairy processors, small-scale, commercial and Fulani Milk Producers do not have access to bundled digital innovations that promotes transparency, efficiency and inclusive market systems. TECH4AG, with support from International Fertilizer Development Centre/2Scale, piloted mDairy innovation with the Dairy Development Programme of FrieslandCampina WAMCO Nigeria PLC in Oyo State.

mDairy application was built using human centred design approach with inputs from farmers and key dairy value chain stakeholders. The pilot was conducted between October 2020-December 2021 at Iseyin, Oyo State. Farmers profiling, milk recording, epayment and web data dashboard features were tested. In addition, 43 Community Livestock Workers (Dairy farmers) and Milk Collection Officers were trained on the use of mDairy. 20 female dairy farmers were empowered with smart phone tablets with preinstalled mDairy application. Dairy farmers (1,048) and milk transporters/aggregators (298) were profiled.

The profiling provides a credible digital identify for the farmers. The digital milk records and payment enables greater transparency, financial inclusivity and efficiency of the dairy value chain most especially for female dairy farmers. It has potential to support farmers with historical milk data to access credits to expand their business.
mDairy digital innovation could serve as a game changer in enhancing transparency and inclusive market systems in the dairy sector. This proven innovation should be supported and scaled-up.

**Key words: mDairy, Dairy farmers, Innovation, FrieslandCampina, 2Scale**


TECH4DAIRY
PROJECT
mDAIRY
mDAIRY

**Modernity, markets and human centric solutions to improve food access in the city of Colombo**

Theme 1: Securing food and nutrition within planetary boundaries

**Anisha Gooneratne**[1]
[1] Colombo Urban Lab

**Abstract/Session concept note text:** Colombo, is home to over 11.4% of Sri Lanka's population, and contributes to a significant portion of the country's demand for food. With little to no agricultural production being undertaken in Colombo and its surrounding areas, the food system is heavily reliant on food being transported across the country to feed its residents. The main wholesale market in Colombo, Manning Market is the main point of access for food in Colombo

However, in 2020 amidst COVID-19 lockdowns, the main market was moved to a new location -far away from the city centre where it previously resided, under the guise of modernity and development. The world class market that was meant to be built, never materialised. Vendors at the new market complain of lack of foot fall, incomplete building finishes, and lack of essential infrastructure to conduct their business. Given that this is Colombo's main wholesale market - any disruption to their activities has consequential effects on food access in the city.

We argue that the lack of human centric solutions when planning, designing and now operating the market has resulted in the shortfalls of the existing market. Our paper draws on the lack of understanding on how vendors interact with infrastructure, such as transportation methods, both into and within the market, cold storage facilities and processing facilities for fruits within the market, to illustrate our argument.

The paper is based on 3 years of research featuring 10 qualitative interviews with vendors in the main wholesale market, tracing their interaction with infrastructure.

**Barriers and opportunities for smallholder farmers participation in formal markets: Lessons from stakeholder meetings between farmers cooperatives and processing companies**

Theme 1: Securing food and nutrition within planetary boundaries

**Nothando Dunjana**[1]
Patience Chauke, Adornis Nciizah, Ernest Dube, Matiga Motsepe, Seneo Madikiza, Madelene Ostwald

[1] Nelson Mandela University

**Abstract/Session concept note text:** Increasing market opportunities for smallholder farmers presents opportunities to improve farmers' income, livelihoods and food access. In most cases, farmers lack the knowledge about existing high potential markets, the confidence and the skills to competitively negotiate. Stakeholder meetings between farmers and representatives of sorghum processing companies, were held in order to understand each side's challenges, expectations and obligations so as to establish a foundation for a mutually beneficial collaboration. While the buyers expressed concern about the limited quantities and poor quality of produce, inconsistency and fragmented sellers, the farmers pointed to limited access to resources as their major constraint. However, pooling of resources in cooperatives helped to partially alleviate this challenge. Another barrier was lack of market awareness, and robust extension services and local economic development initiatives were of paramount importance in this case. An enabling policy environment and the development of key infrastructure including roads, collection points, access to credit and training were largely seen as government responsibility. Private sector, non governmental organisations and development projects were called to partnerships. The issue of prices still remains a challenge, as the buyers could not guarantee prices without samples, price volatility due to macro economic conditions and global crises. However, the dialogue presented an opportunity to assure the farmers of a ready market, and offered guidelines regarding the standard of quality of produce that should be met. Using this experience, it was expected that key stakeholders would understand their role in the market matrix to support sustainable participation of smallholders.

**Farmers income, livelihoods, market access, multi-stakeholder participation**

**Skills, networks, and capital for a sustainable food system**

Theme 1: Securing food and nutrition within planetary boundaries

**John Mugonya**[1]
[1] Agripreneurship Alliance

**Abstract/Session concept note text:** For the past five years, the Agripreneurship Alliance has been working with partner universities in Africa towards a vibrant African agripreneurship to reduce poverty, enhance economic growth and improve food and nutrition security. We aim to promote a holistic and circular agrifood economy in Africa by increasing knowledge, skills, and capital flow to young agripreneurs in Africa. Our programmes empower young African entrepreneurs to develop business ideas and plans that enable the launch and growth of formal sustainable agri-food businesses. We offer two training courses: The Entrepreneurship in Agribusiness course is targeted at university students, and currently the Alliance partners with ten universities and one college in five countries, the Democratic Republic of the Congo, Kenya, Namibia, Somaliland, and Uganda. It is a hybrid course that guides the participants to develop fundable business plans for the budding agripreneurs to launch or grow an agri-enterprise.

In contrast, the Agribusiness Readiness course is delivered face-to-face to smallholder farmers, community groups, and cooperatives with a relatively lower level of numeracy and literacy. This training promotes agriculture as a business and develops relevant skills for business growth, including market positioning and accessing finance. Both courses emphasise sustainability, making participants responsive to their enterprises' social and environmental costs and benefits and increasing the availability of the suitable capacity building, networks, and investment opportunities for young agripreneurs. We are currently undertaking a study to measure our impact and improve programming.

Keywords: agripreneurship, circular agrifood economy, knowledge, smallholder farmers

## Guided poster walks Day 1

**Soil Organic Carbon and CO2 efflux under different grazing Intensities in Miombo woodland in Tanzania**

Theme 1: Securing food and nutrition within planetary boundaries

**Hadija Mchelu**[1]
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**Abstract/Session concept note text:** A healthy soil is fundamental for the world's ecosystems supporting millions of communities in the world. However, increased livestock grazing remains a threat to soil resulting to increased soil heterogeneity, compaction and soil erosion which lowers soil health and productivity. Despite this, few studies have documented the effect of increased grazing intensities on soil health in Miombo woodland. Understanding this, is important for proper soil management, productivity, and ecosystem functioning as a whole. Therefore, this study aimed at assessing the varying pattern of soil C and CO2 efflux under different grazing intensities in Miombo woodlands in Tanzania. Data were collected from nine (9) selected forests found in Kilosa, Kilombero and Handeni districts covering the whole miombo biome found in the country. A total of 198 plots were used to assess SOC and CO2 efflux. A closed chamber system by EGM-5 CO2 gas analyzer was used to measure Soil CO2 efflux in the field. Number of livestock per area and scoring method approaches were used to quantify different grazing intensities. Results revealed that there is a significant difference ($p=0.00010$) in SOC and CO2 efflux between high and light grazing intensities. The study found a negative relationship between high grazing intensity and SOC (%) and positive trend was observed within the medium grazing intensity. We conclude that, increased livestock grazing significantly lowers soil stability to store C however, medium grazing intensity or restricting grazing activities may trigger soil capacity to stores more C.
Keywords: Grazing intensities, Soil health, SOC, CO2 efflux, Miombo woodland

**Sustainable intensification and bioeconomy: Enhancing non-food biomass supply while supporting the resilience of food production systems.**

Theme 1: Securing food and nutrition within planetary boundaries

**Sergio Alejandro Barrios Latorre**[1]
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**Abstract/Session concept note text:** Agriculture is a major source of food production and plays a crucial role in delivering non-food biomass for diverse applications within the bioeconomy. Consequently, discussions regarding resource use allocation and land use prioritization have emerged. The shift towards dedicated energy crop production, for example, can pose a threat to food supply and induce land use change. In order to protect food production from the expansion of non-food crops, the use of residual agricultural biomass, especially straw, has been suggested as a viable alternative. However, the removal of residual crop biomass can jeopardize soil fertility because of the reduction in organic carbon inputs. The establishment of intermediate crops has the potential to counteract the negative effects of residue removal and provide an additional source of biomass. This study analyses the crop residue availability in Sweden along with the potential for the inclusion of intermediate crops in crop rotations. Regional cultivation patterns were analyzed to estimate the total biomass potential of oilseed radish as a model intermediate crop. The contribution of crop residues to the stable soil carbon pool was contrasted with alternative scenarios where the removal of residual biomass is combined with either incorporation or harvesting of intermediate crop biomass. Results suggest spatial variation across the country in the effectiveness of this sustainable intensification strategy. Agricultural regions in Sweden can benefit from the implementation of this practice, strengthening the resilience of farms from both economic and environmental perspectives.

**Effects of grazing pressure on above ground biomass and regeneration limitation on Miombo woodlands.**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** Miombo woodlands are a vital ecosystem in Tanzania, providing habitat for numerous plant and animal species and serving as an essential carbon sink. However, overgrazing has become a widespread problem in the country, potentially leading to decreased plant productivity and biodiversity. This paper analyzes the effects of grazing pressure at four different intensities on the above-ground biomass and regeneration limitation of miombo woodlands. The study was conducted in the Kilombero, Kilosa, and Handeni districts of Tanzania. This study used field observation and surveys on 0.1 ha plots to investigate the effects of grazing pressure on the above-ground biomass of miombo woodlands and their regeneration limitation. The findings indicate that grazing pressure at any intensity has no significant effect on the above-ground biomass of trees but has a negative effect on regenerants. The number of regenerants was found to decrease with increase in the intensity of grazing at an estimate of (-0.88277) and $p > 0.05$. Other variables of regeneration including species richness, evenness and diversity were found to respond differently to the grazing intensities where the highest level of species richness was found in areas with medium grazing intensity ($S = 7.1$) and the highest level of evenness was observed in areas with No grazing activities ($E = 0.873$). The highest level of species diversity was observed in Medium grazing intensity ($H = 1.59$) with least diversity in No grazing ($H = 1.4$). The paper concludes that medium grazing intensity has a positive significant impact on miombo woodland regeneration.

Miombo woodlands, grazing intensity, regeneration limitation.

**Garcinia kola: diversity, utilisation and domestication in Cameroon**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** *Garcinia kola* Heckel (Clusiaceae) is one of West and Central Africa's most popular agroforestry species. Despite its local significance, most of the current research focuses on *G. kola's* therapeutic effects, omitting topics which could lead to the species' advancement in domestication. Therefore, our research aimed to investigate the phenotypic and genetic diversity of *G. kola*, identify plus trees, and explore the species' biochemical potential and utilisation/management by local communities. In total, 122 farmers were interviewed, and 227 trees, along with 1,040 leaves, 1,727 fruits and 4,559 seeds, were evaluated in Cameroon's Southwest, Central, and South regions. Significant regional differences in the utilisation, management and commercialisation of *G. kola* products were discovered. Even though fruit collection was harmless to the tree, bark and root harvesting was found to be invasive, threatening the species' existence in wild stands. Kolaviron, the most investigated chemical compound, appeared overrated in its therapeutic impact. The majority of plus trees, with a higher incidence of domestication-related traits, originated in the South region. However, no significant differences in genotype or phenotype were found between wild and cultivated trees, suggesting that the domestication of *G. kola* is still in its early stages. Promoting the species' therapeutic potential among farmers could be a successful strategy for shifting their focus from the bark to the seeds. Field trials recognising the Participatory Domestication Approach must first be established to test, monitor, and propagate possible cultivars of plus trees and ideotypes.

# REDUCING FOOD WASTE USING SOLAR HYBRID DEHYDRATOR TECHNOLOGY FOR SUSTAINABLE FOOD PROCESSING IN WESTERN KENYA

Theme 1: Securing food and nutrition within planetary boundaries

**Rodgers Oyugi**[1]
[1] Vintage Fibre

**Abstract/Session concept note text:** In Sub-Saharan Africa, root tubers–cassava, potatoes, sweet potatoes, yams, leafy vegetables, and banana crops are the most important staple crops. They provide around 15% or more of the daily per capita calorie intake for the 763 million people living in Sub-Saharan Africa. Often rich in key nutrients such as provitamin A, these crops can significantly improve nutrition and food security. In Kenya, more than 576,000 tonnes of food are wasted every year, and over 2 million Kenyans face hunger yearly. Many can be grown with few inputs and often under harsh conditions and respond very well to intensification, and are high yielders in terms of calories produced per hectare thus can be used to alleviate poverty and hunger, as important cash crops, helping to boost family incomes, frequently grown or marketed by women and youth. However, these crops present challenges such as the crops' bulk and perishability, which put pressure on post-harvest innovations. 55% of what goes to waste could be salvaged, but this is not achieved because the smallholder farmers lack the equipment and technical know-how to process the fresh produce into products that have a higher shelf life and market value. The use of hybrid solar dehydrators helps farmers convert fresh farm products into dried flakes that are then processed into gluten-free flours and other products. The dehydrators can also recycle ash as an alternative insulation polymer. Therefore, the project aims to propose and establish a processing plant and capacity building using a circular business model that can be implemented in some selected rural communities in Western Kenya. Using a decentralized sourcing technique, this project focuses on promoting community-based enterprises targeting youth and women.

**Keywords:** Post-harvest, Hybrid solar dehydrator, Shelf life, Income, Employment,

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**The responses of herbaceous species of miombo woodlands at different grazing intensities in Tanzania**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** The scarcity of grazing resources forced pastoralists to move to the miombo woodland. This practice causes a potential loss of rangeland resources however, literature indicates that pastoralists have coexistence with miombo woodland for centuries. This study proposed to establish the grazing intensities that will assure the holistic existence of miombo woodland and livestock using species composition, richness, diversity and evenness. Data were collected from Kilosa, Kilombero and Handeni Districts. Four grazing intensities (Zero, Light, Moderate and Heavy) were established and assessed in 50X20m plots. The 0.5m x 0.5m quadrat was used to sample the herbaceous species. Species identified and counted for species composition, richness, diversity and evenness. The Cluster Analysis and Shannon winner's index diversity were used to assess the species composition and its indices respectively. A total of 86 species were identified. The key forage species were *Hyparrhenia rufa, Panicum maximum, and Oplismenus hirtellus. G*razing in miombo increased potential forage species in light and moderate grazing intensities than zero and heavy grazing. The heavily grazed areas had more forbs due to the depletion of palatable species. The species diversity, richness and evenness were increased with increased grazing intensity to moderately grazed areas and a decline in high grazing intensity. The forage species were few in the dry season compared to the wet season due to its depletion through grazing and fire. The study recommends light to moderate grazing intensities to increase livestock production and ensure the sustainability of miombo woodland resources.

Miombo Woodland, Grazing Intensity, Species Composition, Season.

# EXPLORING THE ROLE OF LOCAL INSTITUTIONS ON SOCIAL CONFLICTS IN THE KARAMOJA CLUSTER

Theme 2: Governance and rights in food systems: Leaving no one behind

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## Abstract/Session concept note text: Background of the study

Dryland areas in the Karamoja border region have for the past five decades been a. Cross-border and livestock raiding have been of main concern unlike other types of social conflicts at household and community level. Instability and insecurity caused social conflicts has affected governance, food production and household livelihood asset ownership.

These challenges are being exacerbated climate variability and increasing intensity of drought. This is most likely to undermine global and national agendas that aim at enhancing the productivity and social wellbeing of communities through improved access to social services and agricultural productivity.

This study will explore how formal and informal institutions are oriented towards household and community level social conflicts compromise and escalation in the agro-pastoral and pastoral production systems in north-eastern Uganda and north-western Kenya.

## Methodology

The study will be conducted in pastoral and agro-pastoral communities in north-eastern Uganda and north-western Kenya. Both qualitative and quantitative approaches will be conducted. Structured interviews, key informant interviews and focus discussion groups will be conducted to collect data. Regression analysis and thematic analysis will be conducted.

## Expected publication

The role of local institutions on social conflicts in north-eastern Uganda and north-western Kenya

## Panel 5 - Agroecology, Food Sovereignty and Security, and Land Justice

**Agroecology, Food Sovereignty and Security, and Land Justice**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Cristian Alarcon**[1]
[1] SLU

**Abstract/Session concept note text:** Abstract/Concept note for session proposal (roundtable and workshop, 75 minutes):

**Agroecology, Food Sovereignty and Security, and Land Justice**

**(Note: the only date that works for this session is September 26)**

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The conference theme to which the paper relates: **Theme 2: Governance and rights in food systems: Leaving no one behind**This session consists of a roundtable and a workshop. The roundtable will engage a group of panelists, including researchers and actors, in a discussion on the role of agroecology for food sovereignty and food security and how agroecology connects to grassroot agrarian visions on land justice. The session will be organized in connection to the FoodAct research project, an ongoing FORMAS project aimed at exploring prospects of food security through agroecological practices in times of uncertainties and crises. FoodAct develops a comparative approach based on a range of research methods, including participatory ones and case studies in Sweden, Chile and Italy. More specific objectives of FoodAct are: 1) to provide a better understanding of the opportunities that exist for new approaches to sustainable food security based on agroecology by analyzing how current agricultural crises affect food provision, 2) strengthen cooperation and knowledge among practitioners and farmers for agroecological transformations that can contribute to other farmers' re-orientation of their farming systems and 3) provide practical guidance to farmers and policy makers on how to develop agroecology to transform food systems for sustainable food security.

This session aims at expanding the geographical focus of FoodAc and, together with the invited panelist, to discuss how agroecological transformations unfolding across different geographical and socio-ecological contexts relates to questions of food security and sovereignty and how these interplays with struggles for land justice. By doing so, we expect to better understand existing institutional barriers and also the enabling conditions for an agroecology-based food regime transition, and to more deeply understand the strengths and weaknesses of the agroecological practices implemented in each diverse particular setting.

## Panel 6 - Gender-based barriers and opportunities for food security and sustainable agricultural systems

**Gender-based barriers and opportunities for food security and sustainable agricultural systems**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Eirini Daouti**[1, 2]
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**Abstract/Session concept note text:** In the context of burgeoning issues of climate change, biodiversity loss, and geopolitical instability, supporting resilient and sustainable food production systems in the Global South is an urgent priority. Despite the critical role gender plays in food production, discussions around innovative solutions to ensure food security often fail to address gender-based barriers explicitly. Women are primary food producers, yet their contribution and role are frequently overlooked and undervalued. In terms of social dynamics, women face limited access to land, education, and input in decision-making, which are necessary to reach sustainability goals. In addition, while women show higher adaptive capacity and control over the use of agroecological approaches, such as intercropping and agroforestry, there is limited discussion about the extent to which gender-based barriers prevent scaling up their use and potential implications on women's labor. To address those issues, we propose a roundtable discussion that brings together a diverse group of panellists to explore and debate: What are the most pressing gender-based barriers to food production in the Global South, with a focus on sub-Saharan Africa? What policies and communication strategies can be employed to effectively address them? To what extent do gender-based barriers prevent scaling up agroecological approaches and what does scaling up mean for a gender-perspective?

## Panel 7 - Animal production, pastoral and livelihoods

**Antimicrobial resistant Campylobacter is an urgent issue within food production systems in Uganda**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** The widespread overuse of antimicrobials has accelerated the development of antimicrobial resistance (AMR). Resistant zoonotic microbes are spreading within food production systems and are a critical One Health issue. *Campylobacter* spp., causing one of the most common foodborne diseases in humans worldwide, is one example. The aim of this cross sectional study was to investigate the occurrence and diversity of AMR *Campylobacter* strains in broilers, in three districts around Kampala, in Uganda. Cloacal samples and boot sock samples were collected from 28 broiler farms and *Campylobacter* was found in all collected samples (n=194) by bacterial isolation. Antimicrobial susceptibility testing, including five different antibiotics, was performed on 170 *Campylobacter* spp. isolates by disk diffusion. All isolates were resistant to at least one antibiotic, 96 % showed resistance to two antibiotics or more and 16 % were resistant to all five antibiotics. On 25 farms the chickens had been given antibiotics and on 16 of these farms, the chickens were given several different antibiotic classes, according to a questionnaire-based interview at each farm. On 70 % of the farms, antimicrobial treatment instructions were received from drug shops without prescription from a veterinarian, and 50 % of all farmers stated that antibiotics are supposed to be used for preventive purposes. Building resilience in food production systems by limiting the spread of AMR depends on controlling AMR effectively as a shared responsibility between various stakeholders. It is of great importance to reduce the antimicrobial use by access to expert advice, prescriptions and appropriate antimicrobials.

**Does diversity in farm production influence dietary composition of pastoral and agro-pastoral households? Evidence from West Pokot County, Kenya**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** Consumption of part of own-produced food is considered as a sustainable way of achieving dietary diversity and a pathway towards commercialization. However, while some studies have found a positive link between farm production diversity and dietary patterns, others have reported contradictory results. Additionally, there is insufficient information about the association between farm production and dietary diversity in pastoral and agro-pastoral households. The relationship may also differ depending on the study contexts. To address this gap, we used a Poisson regression model to examine the connection between 3 indicators of on-farm production (crop species count, livestock species count and farm production diversity score) and household dietary diversity using data from 232 pastoral and agro-pastoral households in West Pokot County, Kenya. Results show that farm production diversity is significantly associated with the dietary diversity of households. Further, after adjusting for socio-demographic and food purchase characteristics, we find that occupation and household agro-ecological location have a significant association with dietary diversity. These findings show that, while pastoral and agro-pastoral households rely on livestock particularly cattle and goats as their primary food source, diversifying farm production into drought-tolerant crops especially fruits and vegetables can considerably improve their diets. There is need for capacity building and awareness creation strategies that promote "nutrition-sensitive" agriculture among the households. This involves diversifying farming systems to focus on crop-livestock enterprise combinations that are not only suitable in the diverse agro-ecological conditions in West Pokot, but also address the key nutritional deficiencies experienced by most households in the area.

**Evil eye, dirty hands and squirrels– perceptions of mastitis among camel pastoralists in northern Kenya**

Theme 1: Securing food and nutrition within planetary boundaries

**Dinah Seligsohn**[1]
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[2] Kenya Camel Association, Nairobi, Kenya

**Abstract/Session concept note text:** In the Horn of Africa, frequent droughts and erratic rainfall are jeopardising food production. Camels, and their milk particularly, are vital to food security and highly valued among the residents in the arid lands. One of the main obstacles to milk production is mastitis, inflammation of the udder, which negatively impacts milk yield, household incomes, and public health. In this study, we aimed to explore how camel pastoralists perceive mastitis and manage udder health to find treatments, prevention or control measures for mastitis that are feasible and acceptable, and thus possible to implement in the pastoralist setting. The study was conducted in Isiolo County, Kenya, an important hub for camel milk trade. In total, 13 focus groups, encompassing camel owners, herders, milk traders and transporters, participated. The discussions were recorded and transcribed, and the transcripts were subjected to thematic analysis. Emerging themes were occurrence and importance of mastitis, causes, clinical signs and consequences of mastitis and accessibility. Pastoralists had detailed knowledge of clinical signs of mastitis, whereas the concept of subclinical mastitis seemed to be unknown. The understanding of possible causes of mastitis varied greatly and depended on the clinical picture, with for example bloody milk being attributed to the evil eye whereas wounds on the udder were associated with bites from ticks, insects or a ground-dwelling mole rat. This is a first step towards developing and testing preventative measures to improve the udder health in camel pastoralist herds.

*Keywords: Milk production, pastoralist, camel, participatory epidemiology, udder health*

**Sustainable intensification of Zambian goat production in a changing world**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** Goats possess unique potential for increasing resilience of poor farming households as they can survive and produce even under difficult conditions such as harsh climates and scarcity of feed. In combination with being cheaper to purchase than for example cows and reproducing quickly, this makes goat keeping an opportunity for poverty reduction and for ensuring food security. Despite this they are often overlooked in agriculture policy and development projects. To support sustainable and resilient goat production, this project will examine the impact of training interventions on goat keeping, goat health, and trading behaviors. Goat-keeping and trading practices among smallholders, cooperatives, and large-scale farmers will be investigated and a survey of goat health, particularly in relation to climate-sensitive and other important infectious diseases, will be performed.

In an inception workshop, stakeholders were invited to discuss climate changes in Zambia, impact on goat keeping as well as to prioritise diseases including any recent changes in occurrence. The results indicate that climate changes are pertinent in Zambia, manifested as extreme temperatures, frequent droughts, erratic rainfall, and flooding. These changes further affect goat farmers, causing changes such as internal migration, habitat loss and increased pressure on feed and water resources. Many diseases were mentioned, with parasitic diseases, tick-borne diseases and orf being prioritised. Orf was the only disease mentioned by all groups as an emerging disease.

The findings will contribute to achieving healthier, more productive goats, which is crucial for alleviating poverty and ensuring food security.

**Keywords: goats, poverty alleviation, food security, climate-sensitive diseases**

## Panel 8 - Gender and human rights approaches to food productions

**Our Kigali? Intersections of gender and age in the formation of livelihoods and positionalities of urban and peri-urban farmers in Kigali, Rwanda**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Karolin Andersson**[1]
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**Abstract/Session concept note text:** The City of Kigali embarks on a trajectory of urban redevelopment of infrastructure, housing and other urban land uses. The city's development plan, Kigali Master Plan, is promoted with the slogan *Yacu Kigali*! (Our Kigali!) and envisions Kigali as an African metropolis by 2050 where urban agriculture is gradually phased out and relocated to rural areas. Nevertheless, agriculture remains a widespread practice throughout Kigali's urban and peri-urban valleys and hill slopes. It provides farmers, a majority of whom are women, with employment, income and food and offers the city's fast growing non-farming population significant volumes of fresh food to lower prices than food transported from elsewhere. In this paper which is based on qualitative fieldwork in Kigali during April-May 2023, I will analyse how intersections of gender and age mediate urban farmers' livelihoods, agency and positionalities in the ongoing transformation of the city. Preliminary impressions from the empirical material indicate that farming is one of few livelihood opportunities especially for women farmers in Kigali, and that the ongoing and planned removal of their urban farmland in Kigali shape new gendered socio-spatial practices, social relations and positionalities that mainly, but not only, undermine urban food security, livelihoods and well-being.

**Keywords:** urban agriculture, urban development, gender, Rwanda, intersectionality

# FOLLOWING IN THE FOOTSTEPS OF THE SUCCESSFUL SPICE FARMERS: DIVERSIFICATION AND GENDER INCLUSIVENESS AS DETERMINING FACTORS

Theme 2: Governance and rights in food systems: Leaving no one behind

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**Abstract/Session concept note text:** This study assessed factors influencing spice income in Tanzania. The research explores the effects of spice diversification, gender inclusiveness, and the impact of socio-economic and land characteristics on spice income. Data from 542 randomly sampled households and ordinary Least Square Regression was used. Findings reveal that cloves and cinnamon were the top contributors to the total spice income. Spice diversification significantly improves spice income, however, over-diversification reduces technical efficiency. Gender inclusiveness also positively influences spice income. Results further indicate that successful farmers receive a higher price for most spices. The study suggests that policymakers and practitioners should encourage farmers to diversify spices, promote gender inclusiveness, and intensify the use of improved technologies. Promoting cooperation among farmers, improving marketing infrastructure and education programs could equip farmers with the necessary knowledge and skills to better negotiate prices and reduce income differences among farmers.

Keywords: Spice farming, Spice income, Diversification, Gender inclusiveness, Tanzania

**BEYOND THE HUMAN RIGHT TO FOOD: THE CONTRIBUTION OF THE PRINCIPLE OF EQUITY AND POVERTY ERADICATION TO REACHING SDG2 ON ZERO HUNGER**

Theme 2: Governance and rights in food systems: Leaving no one behind

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**Abstract/Session concept note text:** From an interdisciplinary perspective that combines international law, food policy analysis and complex systems thinking, this work examines the main challenges to the implementation of the sustainable development goal 2 (Zero Hunger), in a very worrying international context. According to the latest data, we are getting further and further away from fulfilling the main objective of this goal: ending hunger. Therefore, this article pays attention to two structural obstacles that hinder its achievement: on the one hand, the overcoming of several planetary boundaries that are leading the world to an environmental change that will very likely have devastating effects, and, on the other, the decrease in the availability of cheap energy sources, on which the global food system is heavily dependent. Against this backdrop, this work explores the role that the human right to food can have in facing these existential challenges. This human right is considered a very useful tool to improve access to food for the most vulnerable people, such as smallholder farmers, poor urban dwellers, indigenous groups, and women, children and youth; however, it presents some relevant conceptual limits that make it difficult to incorporate int a sustainability dimension, crucial to maintain the food system within planetary boundaries and in a context of energy descent. Given those limits, this paper defends the need to contextualise the human right to food in the Anthropocene, and explores a specific strategy to complement it: the principle of inter and intragenerational equity.

**Gender-based approaches for improving milk safety, value addition and marketing among smallholder livestock farmers in Western Uganda**

Theme 1: Securing food and nutrition within planetary boundaries

**Judith Irene Nagasha**[1]
Michael Ocaido[2], Elisabeth Rajala[3], Assem Abu Hatab[3], Linely Chiwona-Karltun[3]
[1] Kyambogo University
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[3] Swedish University of Agricultural Sciences

**Abstract/Session concept note text:** In Uganda, women play a significant role in activities related to dairy production. This study investigated how gender-based approaches for improving milk safety, value-adding activities, and marketing access practices of women among smallholder livestock farmers in western Uganda may enhance their participation. The specific objectives were to i) identify and document current milk safety practices, value addition, and marketing channels used by women; and ii) investigate constraints, opportunities, and strategies for the production of safe milk and milk products and to access sustainable markets. Both qualitative participatory approaches and structured questionnaires were used to collect data from four sub-counties in Kiruhura district from both women and men. The results indicated that women were more likely to undertake milk safety procedures compared to men. Women were constrained in accessing adequate quantities of milk for butter and ghee processing, as well as for cosmetics production. There was a clear gender gap in women's capabilities, knowledge, and appropriate technology use regarding milk value addition. To address this gender gap, both men and women should be involved in decision-making and participate equitably in the milk value chain. Improving women's access to adequate milk quantities for production and value addition strengthen livelihoods and dairy production in Kiruhura, western Uganda.

**Keywords**: Gender, milk value addition, smallholder livestock farmers, western Uganda.

## Panel 9 - A more robust food supply – research in and for uncertain times (Part 1)

**A more robust food supply – research in and for uncertain times (Part 1)**

Theme 1: Securing food and nutrition within planetary boundaries

**Elin Röös**

**Abstract/Session concept note text:** Making the food system more resilient and robust is of utter importance to supply sufficient and nutritious food to all. At the same time, agriculture and food production need to become more environmentally and socially sustainable. In this session we will present 10 newly started projects that were all funded by Formas as part of their call "Sustainable food supply in uncertain times". Projects span a wide variety of subjects all related to accomplishing a more robust and sustainable supply of food. Projects will target the rearing of ruminant livestock in times of water shortage in both low- and high-income settings and ways to decrease greenhouse gas emissions from dairy using Science Based Targets. Two projects revolve around the production of sustainable plant-based foods including those based on novel feedstocks such as lignocellulose. Several project are carried out in close collaboration with food system actors and society, including action oriented research related to agroecology carried out both in Chile, Italy and Sweden, resilient food supply in municipalities and an innovation lab for sustainable preparedness. One project will conceptualize the idea of sustainable preparedness and develop indicators for its governance. Finally, one project will look at the production and supply of nutrients to farming – a crucial resilient aspect for ensuring food production. During the session we will present the projects shortly, discuss the most pressing research needs that the projects should focus on and gather feedback from stakeholders.

# Panel 10 - From Project interventions to Transformative Impacts: Charting Paths for Sustained Adoption of Agri-Food Innovations

**From Project interventions to Transformative Impacts: Charting Paths for Sustained Adoption of Agri-Food Innovations**

Theme 2: Governance and rights in food systems: Leaving no one behind

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**Abstract/Session concept note text:** Sustainable agriculture and resilient food systems require farmers to adopt agri-food innovations. Many development initiatives have promoted promising innovations, but achieving sustained adoption is challenging. Project interventions often witness fleeting uptakes, with many farmers reverting to traditional practices when project cycles are over. This "project syndrome" phenomenon is a well-known issue in agricultural development, where farmers' adoption behavior is driven largely by project incentives rather than a genuine acceptance based on the potential benefits of the innovations, hindering widespread impacts and a desirable systemic change. It calls for a shift from a project-centric approach to a more transformative one that prioritizes farmers' buy-in, stakeholder engagement, and co-execution of innovation processes and outcomes.

This interactive dialogue session will bring together a diverse group of stakeholders, including researchers, practitioners, donors, policymakers, agro-dealers, and farmers, to discuss and chart the paths for sustained adoption of agri-food innovations. We will explore the incidence, underlying causes, and consequences of project syndrome and identify strategies to encourage organic and transformative adoption of Agri-Food innovations. The session will begin with a keynote presentation, setting the stage for subsequent interactions. Then, a panel discussion featuring experts from different regions with first-hand experience, insights, and recommendations to facilitate sustained adoption will follow. Among other relevant topics, the panel will provide perspectives on farmer-centered design and co-creation, local capacity-building, market incentives and value chains, and policy and governance frameworks. Participants will have the opportunity to ask questions to the panel, share ideas and experiences, and co-create strategies necessary to achieve sustained adoption of agri-food innovations, leading to a lasting impact on the lives of farmers and their communities. Overall, this dialogue session provides a valuable platform for advancing the discourse on the sustained adoption of agri-food innovations and for catalyzing collective action towards transformative change.

Keywords: Short-lived farmers' adoption, Project syndrome, Sustained uptake, Farmer-centered design, Transformative change

## Panel 11 - Agroforestry: From Asia to Africa

**Strengthening Policy Support for Smallholders under the EU Deforestation Regulation in Southeast Asia**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Kuntum Melati**[1]
Pimolporn Jintarith[1], Haeun Lee[1], dimas fauzi[2]
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**Abstract/Session concept note text:** Governments and policymakers continuously making efforts to address climate change and mitigate associated activities that contribute to its impacts on the agri-food systems. One of the examples is the EU Deforestation Regulation (EUDR), designed to minimize deforestation risks and ensure that exported commodities are traceable to attain zero-deforestation supply chains. However, it is crucial to understand the implication to smallholders, particularly in Southeast Asia, where an estimated 100 million smallholders are small-scale agri-food producers. This paper aims to unpack how the policies could be made better for smallholders, and our recommendations outline as follow: (1) While the policy seeks to tackle environmental issues, it does not adequately address the inequality in the value chain, especially with limited support received by smallholders. (2) It is crucial to adopt a system design thinking which provides a better understanding on effective ways to support sustainable value chains while empowering smallholders to address climate change. (3) A collaborative and concerted approach is necessary to support smallholders, especially if the EU aims to reduce greenhouse gas emissions and halt biodiversity loss. We argue that by addressing these considerations, policymakers can enhance the effectiveness of EUDR and other potential "green" policies to ensure a more inclusive and sustainable supply chain.

**Fruit-tree based agroforestry for a sustainable farming system in the sloping uplands northwest Vietnam**

Theme 1: Securing food and nutrition within planetary boundaries

**Van Hung Do**[1, 2]
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**Abstract/Session concept note text:** Northwest region of Vietnam, conventional agriculture is dominated by sole crop cultivation on steep slopes, including extensive tillage and crop residue burning. This is accompanied by extensive degradation of land and other natural resources and un-sustainable production systems. Our aim was to assess the productivity and environmental benefits of fruit tree agroforestry on steep slopes. We compared two-agroforestry systems on sloping land in northwest Vietnam, one that included longan (*Dimocarpus longan* L.)-mango (*Mangifera indica* L.)-maize (*Zea mays* L.)-forage grass (Guinea grass-*Panicum maximum* Jacq.), and one that included son tra (*Docynia indica* (Wall.) Decne.)-coffee (*Coffea arabica* L.)-forage grass with sole-cropped maize and sole-cropped coffee, respectively. We quantified tree/crop production, measured soil and nutrient losses using soil traps and estimated terrace formation over a five-year period. The results showed that agroforestry systems delivered earlier and more diverse products than sole-crop systems. During years 1-2, the primary products were fodder grasses and crops, and the products became more diverse when the trees bearing fruit in years 3-4. In addition, agroforestry systems reduced losses of soil, organic carbon and related nutrients (N, P, and K) significantly compared to sole-cropped systems already in the first two years, but the impacts were greater in years 3 and 4. Furthermore, terraces were typically developed in agroforestry systems by the progressive deposition of soil sediments above growing grass strips and trees. Our findings revealed that the fruit tree agroforestry with grass strips could be a useful management practice and viable option for sustainable agricultural systems in steep slopes.

*Keywords*: Fruit-tree based agroforestry; productivity, soil and nutrient mitigation, steep slope; sustainable farming

**Human Rights-Based Approach for attaining food, nutrition and income security: A case of Agroforestry for Livelihood Empowerment Program**

Theme 2: Governance and rights in food systems: Leaving no one behind

**EDNA LUGANO**[1]
[1] Jennifer Wambui

**Abstract/Session concept note text: Theme 2:** Governance and Rights in food systems: Leaving no one behind

**Title: Human Rights-Based Approach for attaining food, nutrition, and income security: A Case of Agroforestry for Livelihood Empowerment Programme**

Global food systems face various challenges and poverty is among them. Poverty persists because of the existing inequalities, ranging from those associated with gender to policy frameworks. In developing countries, gender inequalities tailored by cultural norms undermine women's rights to decisions making and ownership of economic resources despite of their significant contribution to the agricultural sector which is the major source of food and income. Countries' policy frameworks consider poor citizens including the smallholder women and men farmers as passive receivers of public services and not key players; hence are left out of the development processes.

Agroforestry for Livelihood Empowerment Programme implemented in Kenya, Uganda, Rwanda, and Tanzania by Vi-Agroforestry, adopted the Human rights-based approach to ensure inclusive and equitable public participation in decisions making from household to national levels for attaining a sustainable environment that enables women and men living in poverty improve their lives. This paper draws lessons from this programme on how addressing cultural gender norms along with agriculture development interventions increases women's access to decision-making and control over economic resources. Also, how the empowered smallholder farmers actively hold duty bearers accountable, hence the accomplishment of the abandoned agriculture projects and resolutions of a community conflict over resources. Mutual accountability and gender transformation are catalysts in interventions to achieve 'Zero hunger'.

**Light distribution and interception in fruit-crop agroforestry practices on sloping land**

Theme 1: Securing food and nutrition within planetary boundaries

**Huu Thuong Pham**[1, 2]
Nguyen La[2], Göran Bergkvist[1], Ingrid Öborn[1], Rachmat Mulia[2], Sigrun Dahlin[1]
[1] Swedish University of Agricultural Sciences
[2] World Agroforestry (CIFOR-ICRAF)

**Abstract/Session concept note text:** Agroforestry is expanding as an alternative sustainable agricultural approach on the sloping lands of Northwestern Vietnam. A fundamental expectation of agroforestry practices is to optimize the resources captured by crops to generate yield. To optimize these systems, adjustments, and management are needed over their lifetime This study assesses the distribution and interception of light in agroforestry practices on sloping land temporally and spatially. We expect to provide scientific evidence supporting redesign and management practices of agroforestry on sloping land.

Two field experiments with fruit trees and maize or coffee were selected, each fruit-crop treatment was divided into 9 zones based on the distance from the tree row: zones 1 to 4 upslope and 6 to 9 downslope of the tree rows. In these, the incident light, its interception by crop, and light reaching the ground was measured repeatedly in agroforestry treatments and compared sole crops as controls.

Incident light to the crop canopy was highest in the sole-crop system. The fruit trees reduced light incidence and capture, and crop yields significantly more downslope than upslope the tree rows. of total radiation could reach ground level, being highest during off-maize season. Light interception by maize was significantly correlated with growth and yield, but no relation with coffee was found.

This study provides evidence for redesigning agroforestry practices and management on sloping land to optimize light capture. Still, more research is needed to determine light requirements and management practices by different species.

**Keywords**

*fruit-crop agroforestry, agroforestry, sloping land, light distribution, light interception*

## Panel 12 - Indigenous knowledge production and rights in food system

**Evaluating the diversity of knowledge about medicinal plants among three ethnic groups in South-central Ethiopia**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Sintayehu Tamene**
Fortunatus Makonda, Mesele Negash, Linley Chiwona

**Abstract/Session concept note text:** More than 60% of the global population, including 80% in developing countries, rely almost entirely on traditional medicine for primary healthcare. However, the majority of previous studies have focused on rural areas, and the topic of traditional medicinal plant knowledge in urban and periurban settings has been marginalized and understudied. The objective of this study is to document and evaluate the use of traditional medicinal plant knowledge by three different ethnic groups, namely Sidama, Oromo, and Gedeo, living in peri-urban areas of south-central Ethiopia. Semi-structured questionnaires, in-depth interviews, field observations, and group discussions with 189 traditional healers were employed to collect data. Several ethnobotanical indices, such as the informant consensus factor, cultural importance, use value, the relative frequency of citation,
and the relative importance index, were used to analyze and express the relevance of medicin al plants. 189 medicinal plant species used to treat 100 ailments were documented. The Sida ma, Gedeo, and Oromo ethnic groups reported 28, 34, and 38 percent of therapeutic plants, r espectively. Species *Albizia gummifera, Aloe macrocarpa, Croton macrostachyus, Ruta chal epensis, Vernonia amygdalina, and Zingiber officinale* received the highest rank to treat vari ous ailments. The highest informant consent value was found for circulatory system disorder s (0.68), followed by reproductive organ disorders (0.66), and spirituality disorders (0.66). A mong evaluated sociodemographic factors, age was found to be a major factor influencing re spondents' local ethnobotanical knowledge ($R^2 = 0.34$ and p-valu = $2.2^{e16}$). Documenting ethnomedicinal species and their therapeutic applications will encourage more phytochemical and pharmacological research, potentially leading to the development of new drugs and, at a minimum, preventing the loss of indigenous knowledge associated with local flora. The current study, on the other hand, revealed
that traditional medicinal plant treatment is still widely practiced in the study area, and detail ed investigations and documentation of indigenous knowledge and associated flora are neede d before it is lost.

**Sundanese Eco-Gastronomy : Build Back Better Ecology With Ethnofood and Ethnobotany**

Theme 1: Securing food and nutrition within planetary boundaries

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[2] Social Enterprise Gastro Tourism Academy

**Abstract/Session concept note text:** Sundanese Eco-Gastronomy is a movement against forced development to accelerate infrastructure without regard to environmental impact analysis on the productive agricultural lands of the Sundanese indigenous people as well as plantations and food forests in Tasikmalaya, West Java, Indonesia. This research uses multispecies ethnography starting from 2020 - 2025 which involves ecological elements in Tasikmalaya from several ecosystems. The movement began on April 2020 when the Covid-19 pandemic spread the information and groups of workers who were Sundanese ethnic working in the capital city was hit by unilateral layoffs, downsizing the workforce, workers were laid off and all workers worked in the sector : gastronomy (gastro tourism and food tourism, restaurateur, food review, food stylist, food taster, food historian), nutrition (nutritionist) and agriculture (agronomist, food technologist, food analyst) to restore the essence, function and history of the Sundanese people in life, namely: farming, raising livestock, gardening, and managing natural resources, substituting urban knowledge and experience with rural ones, transforming from an urbanism lifestyle to a very communal ruralism and having mutual cooperation and not thinking about wages. The eco-gastronomic mission is creating a post-harvest management entrepreneurial group for managing short food sales systems with local distribution, the purpose are : (1) a social movement of workers who bring awareness to local food shortages and farming (2) empathy for food availability and local entrepreneurs who can process local food commodities with ethnofood and ethnobotanical history of the Sundanese people with their ancestral recipes and give them prosperity.

**Building Resilience through Revitalisation of Indigenous Food Systems in the Northern Province, Sri Lanka: A Case of Nourish North Initiative**

Theme 1: Securing food and nutrition within planetary boundaries

**Prabu Nadaraja**[1]
Shribavan Kanesamoorthy[2]
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**Abstract/Session concept note text:** Sri Lanka, a biodiversity hotspot in South-Asia, harbours approximately 4,500 edible species deeply ingrained in its indigenous medical tradition. Unfortunately, the nutritional value of many of these species goes underappreciated, pushing them towards extinction. The Northern region of Sri Lanka has experienced recurrent food shortages during the 30-year civil war, tsunami, extreme weather events, the Easter bomb attack, and COVID-19. In 2022, Sri Lanka has experienced most serious economic crisis since independence which provoked currency devaluation and skyrocketing of food prices amid soaring unemployment rates, further exacerbated food insecurity.

Under the Nourish North Initiative, launched in mid-2022, indigenous medical practitioners empowered rural women to identify and consume edible greens, yams and fruits in their vicinity. Traditional diets were rediscovered through collaborative knowledge-sharing between practitioners and community members. Rural women integrated these wild species, which can withstand extreme weather, into home gardens to ensure daily availability. The value addition of rediscovered edible plants commenced, and products were locally marketed through women's cooperatives.

In just one year, both the variety of crops grown in backyard gardens and the diets of rural women improved. The initiative provided a sustainable and culturally appropriate solution by valuing traditional knowledge, leveraging biodiversity, promoting local production, and enabling the participation of underrepresented groups. This unique approach to revitalising indigenous food systems and building food system resilience in the face of climate change through collaborative efforts will be discussed, highlighting its novelty and effectiveness.

Key words: Indigenous Food Systems, Sri Lanka, Climate Change, Biodiversity Loss, Resilient Food Systems

**Films as human rights: through the lens of Indigenous Peoples' forest food**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Purabi Bose**[1]
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**Abstract/Session concept note text:** From my book chapter: Among various forms of communication, a combination of audio-visual formats like films is increasingly used in promoting human rights. Indigenous Peoples' rights to forest food in India are being amplified through a film, TARA *Alpinia nigra*. This article examines how common resources, such as wild edible forest food, when turned into commodities violate basic human rights to the culture and health of India's Indigenous Peoples. When a human rights violation happens, it means that person's humanity has been denied. Often, human rights violation is expressed in statistics (numbers) or via legal bindings (treaties, policies), which fail to have a human touch. Filmmaking on human rights violations touches that human element by shedding light, camera, and action by amplifying the voices of the 'human beings', the real protagonists. This article demonstrates the role of film in documenting the 'way of living and traditional right to sustainable forest food for Assam's – North-East province in India – hunting-gathering Indigenous communities. It elaborates how films can become a powerful medium when the human 'rightsholders' are given a space to voice their opinions in front of the lens. The conclusions point out two ways forward: (a) the films become a lens of justice by letting real people talk in front of the camera rather than voice-overs by the 'beholders' of human rights, and (b) Indigenous Peoples are aware of their traditional rights to forest food as commons.

## Panel 13 - A more robust food supply – research in and for uncertain times (Part 2)

**A more robust food supply – research in and for uncertain times (Part 2)**

Theme 1: Securing food and nutrition within planetary boundaries

**Elin Röös**

**Abstract/Session concept note text:** Making the food system more resilient and robust is of utter importance to supply sufficient and nutritious food to all. At the same time, agriculture and food production need to become more environmentally and socially sustainable. In this session we will present 10 newly started projects that were all funded by Formas as part of their call "Sustainable food supply in uncertain times". Projects span a wide variety of subjects all related to accomplishing a more robust and sustainable supply of food. Projects will target the rearing of ruminant livestock in times of water shortage in both low- and high-income settings and ways to decrease greenhouse gas emissions from dairy using Science Based Targets. Two projects revolve around the production of sustainable plant-based foods including those based on novel feedstocks such as lignocellulose. Several project are carried out in close collaboration with food system actors and society, including action oriented research related to agroecology carried out both in Chile, Italy and Sweden, resilient food supply in municipalities and an innovation lab for sustainable preparedness. One project will conceptualize the idea of sustainable preparedness and develop indicators for its governance. Finally, one project will look at the production and supply of nutrients to farming – a crucial resilient aspect for ensuring food production. During the session we will present the projects shortly, discuss the most pressing research needs that the projects should focus on and gather feedback from stakeholders.

# Panel 14 - Food productions and innovations

**Utilizing a Hydroponic Shipping Container Farm for Food Systems Education: A Case Study**

Theme 1: Securing food and nutrition within planetary boundaries

**Gabrielle Edwards**[1]
[1] University of British Columbia

**Abstract/Session concept note text:** Hydroponic shipping container farms (HSCF) are an emerging tool within educational settings that can be used to increase availability of healthy and local produce and create opportunities for young people to connect with food systems and the environment. A year-long case study was conducted at a school in British Columbia, Canada that was in its first year of implementing a HSCF program. The school was attempting to integrate the program using a whole school approach which recognizes that formal learning, school environment, and community connections all contribute to student learning. The research questions aimed to identify barriers and opportunities that arose during program implementation as well as how a food literacy program is affected when commonly identified barriers to program success were absent. This research included the voices of many individuals including teachers, administrators, students, and community members. The study found that, in addition to providing food and educational opportunities for students in the school, the HSCF program also acted as a catalyst for engaging the school and wider community in sustainability-related actions not directly tied to the HSCF's activities. However, despite substantial initial funding for program implementation and support, the presence of the HSCF at the school placed significant financial and human capital burdens on the school which puts the long-term sustainability of the program into question.

**Kharchia wheat from Pali, India: a local landrace showcasing resilience under Saline Agroecosystem**

Theme 1: Securing food and nutrition within planetary boundaries

**Dheeraj Singh**
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**Abstract/Session concept note text:** A wide variety of traditional cultivars are being conserved by farmers across the world, which is crucial for adaptation of climate change. With these factors in mind, an investigation was undertaken in the Pali district of Rajasthan, India, to figure out farmers experiences about maintaining and disseminating a local landrace of wheat referred to as Kharchia, that's is the highest salinity-tolerant variety of wheat in the world. The findings revealed that most farmers believe it is vital to plant Kharchia wheat since this variety is the only kind that, no matter how severe the circumstances are, can withstand the region's harsh conditions of salty soil, salty water, and high temperatures while maintaining some yield. Another reason of inevitability of kharchia wheat is that it can be grown on conserved soil moisture as rainfed crop which is not possible with any other improved varieties of wheat. For farmers who do not believe that growing kharchia wheat is inevitable for better adaptation to harsh local conditions, their reasons had to do is failure of the kharchia wheat to be productive enough, lack of tolerance to disease and susceptible to lodging. Majority of the farmers grow this land race due to its high seed viability and ability be used for cultivation for years together without any decline in yield or plant characters. Besides other characteristics farmers are of the opinion that in addition to the grain yield, the fodder yield is also high and is liked by animals.

**Greenhouse Farming Technology as Climate-Smart Agriculture: Heterogenous Effects on Farm Performance in Ghana**

Theme 1: Securing food and nutrition within planetary boundaries

Dora Akpene Torsu[1]
**Gideon Danso-Abbeam**[2, 3], Abiodun A. Ogundeji[3], Victor Owusu[4], Enock Owusu-Sekyere[5]
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**Abstract/Session concept note text: Abstract**

The role of climate-smart agriculture (CSA) practices in the transformation of food systems is well documented in the literature. Green House Technology (GHT) as CSA is intended to increase farm productivity and income. However, the magnitude of the impact of adopting GHT developed for adaptation and mitigation to improve vegetable farm performance has been underexplored in development studies. This study evaluates the heterogeneous impact of GHT adoption on vegetable farm performance in Ghana. The study employed the Marginal Treatments Effect (MTE) model, which corrects for both observed and hidden endogeneities to quantify treatment effects heterogeneities as well as policy-relevant treatment effects (PRTE). According to the findings, farmers with more hidden characteristics are more likely to adopt GHT. Furthermore, GHT adoption leads to significant economic gains, and GHT adoption has heterogeneous effects among the adopters' group. Thus, an average GHT adopter gains approximately 191.71 and 56.32% more farm yield and net farm revenue (indicators of farm performance) than they would have earned in the non-adoption state. If non-adopters had adopted, they could have increased farm yield and net farm revenue by about 176.39 and 97.75%, respectively. The PRTE indicates that increasing access to market and climate information has a great potential of increasing GHT adoption, and consequently improve farm performance. Therefore, development agencies should make conscious effort to promote sustainable agricultural technologies such as GHT to mitigate the negative effects of climate change, and increase farm incomes.

**Greenhouse study of growth-promoting bacteria to improve drought tolerance in quinoa**

Theme 1: Securing food and nutrition within planetary boundaries

**Virginia Gonzales**[1, 2]
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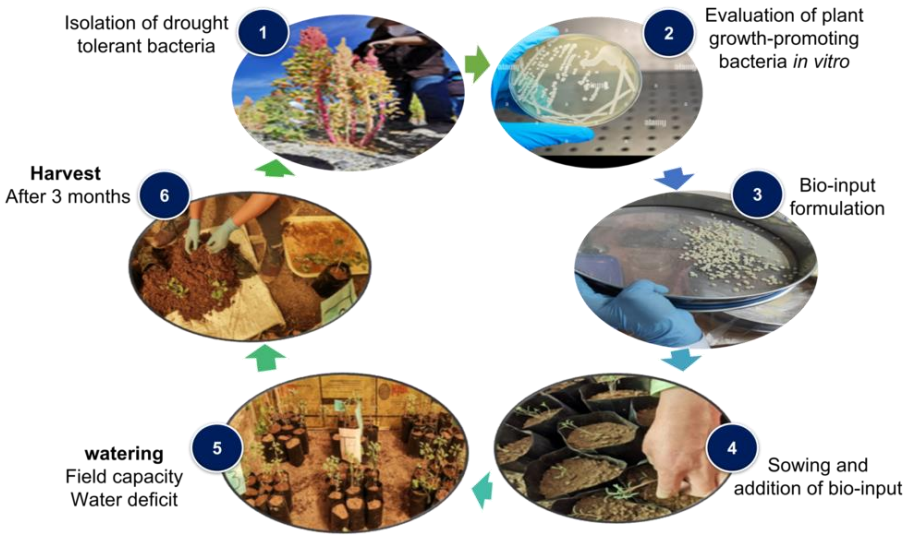
**Abstract/Session concept note text:** Quinoa is a nutritious pseudocereal, considered a crop of the future because of its ability to survive in harsh environments. Bolivia is the world's largest producer of organic quinoa, although climate change is negatively affecting its yield and soil quality. Beneficial microorganisms can provide nutrients to plants and improve tolerance against abiotic stresses like drought. Through this study, native quinoa rhizosphere microorganisms were evaluated as potential plant-growth promoters under drought conditions. A greenhouse experiment was established at Agronomy's Faculty-UMSA, Bolivia (May-July 2022) in a completely randomized block experiment. Seven drought-tolerant bacterial strains isolated from southern highlands were formulated as bio-input in beads (carrageenan 5.6% w/v, $10^8$ cfu/mL). Three grams were applied 20 days after sowing, at branching stage. Then, irrigation levels (100 and 50 % field capacity) were established. Destructive sampling allowed us to analyze agronomic parameters and the effect of bacterial inputs. The bio-input formulated with strain 4 promoted a significant increase ($p<0.05$) in total seedling length under 50% irrigation level and root length under normal irrigation conditions ($p<0.05$). A highly significant increase in total seedling and root length ($p<0.0001$) was observed with strain 2 under 50% irrigation. Results are related to plant growth promoting effect of bacterial strains and their ability to induce drought tolerance at early growth stages. We consider the application of beneficial microorganisms to be a sustainable and environmentally friendly alternative for organic quinoa producers.

**Keywords:** bacteria, drought tolerance, plant growth promotion, quinoa.



## Panel 15 - Modelling, innovation and big data for sustainable food system

**Moving beyond the productivity paradigm: Agricultural innovation systems and sustainable transformation in Africa**

Theme 1: Securing food and nutrition within planetary boundaries

**Thomas Daum**[1]
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**Abstract/Session concept note text:** Innovations can play a crucial role in transforming agriculture, and the "agricultural innovation system" has become a widely accepted framework for guiding public action to support innovation. Traditionally, agricultural innovation systems in the Global South have often focused on increasing agricultural productivity to reduce hunger and poverty. While this remains a critical goal, meeting the Sustainable Development Goals requires innovation that addresses multiple sustainability objectives. These include promoting healthy diets, ensuring an inclusive and just agricultural transformation, protecting environmental health, and building resilience to climate shocks. As agricultural transformation goals have expanded, it has become clear that innovation systems must be redesigned to embrace multiple sustainability goals. This paper examines the extent to which agricultural innovation systems in Benin, Kenya, Mali, and Nigeria prioritize multiple sustainability goals, identifies trends, opportunities and challenges, and proposes strategies for moving beyond the productivity paradigm. To gain a comprehensive understanding, we conducted mixed-methods data collection, including qualitative interviews with around 120 managers and a quantitative survey of approximately 1,200 staff members from 48 organizations across three types of innovation system actors: agricultural research, agricultural extension, and education. Our research identifies key factors and actors necessary to enable a transition from a productivity-oriented to a sustainability-oriented innovation system. These factors include visions, goals, and capacities, partnerships and networks, and incentives, funding, and regulatory frameworks. By focusing on these key elements, it is possible to enable a transition towards an agricultural innovation systems that ensures sustainable agricultural transformation.

**Agriculture expansion into forest reserves in Zambia: A remote sensing approach**

Theme 1: Securing food and nutrition within planetary boundaries

**Justin Munyaka**[1]
Darius Phiri[2], Kennedy Kanja[3], Philimon Ng'andwe[2], Jacob Mwitwa[3], Petan Hamazakaza[2], Felix Chileshe[2], Sydney Kapembwa[2], Jane Musole Kwenye[2]
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**Abstract/Session concept note text:** Forest reserves play an important role in climate change mitigation and the provision of various ecosystem services. However, increasing demand for agricultural land have caused increasing anthropogenic impacts. Studies in sub-Saharan African countries have focused on deforestation and its drivers with lack of understanding the extent and impacts of agricultural expansion into forest reserves. This study aimed to assess the extent of agricultural expansion into forest reserves in Zambia on a national scale between 2000 and 2018 and explore the drivers. A remote sensing approach by employing Google Earth Engine (GEE) and random forests to map land cover changes at five-time steps: 2000, 2005, 2010, 2015 and 2018. Landsat and Sentinel-2 images were used to map six land cover classes (forests, cropland, wetland, grasslands, settlements, and others). A social survey was used to understand the drivers of agricultural expansion into forest reserves. Land cover maps were produced with high overall accuracies ranging from 82% to 94%, with land cover maps based on Sentinel-2 images having higher accuracy. The results indicated a general decline of 10% in forest area and an increase of 25% in cropland. Almost 50% of the forest reserves in Zambia are experiencing some form of encroachment, and 10% of these are heavily encroached (>90% forest loss). Communities indicated that the ever-increasing demand for land drives agricultural expansion. This study highlights the need for consideration of trade-offs in agricultural expansion. Policymakers need to take urgent steps to address the ever-increasing agricultural expansion into forest reserves.

**The Global Subnational Agricultural Platform (GSAP): Addressing the Information Gap in Agricultural Production data for Improved Food Security**

Theme 1: Securing food and nutrition within planetary boundaries

**Rafaela Flach**[1]
Javier Godar[1]
[1] Stockholm Environment Institute

**Abstract/Session concept note text:** Mapping agricultural production and estimating agricultural productivity across the globe are essential for food security interventions and rural development policies. However, the lack of a global database on subnational agricultural production severely hampers the analyses and policy-making efforts of researchers, practitioners, and policy-makers in various fields. The Global Subnational Agricultural Platform (GSAP) dataset is the first standardized global subnational agricultural production database that covers key global crops and is both updated (2010-2021) and comprehensive in country coverage. The finer scale of GSAP data allows for a better integration with Earth observation and socio-economic data, allowing for more accurate analyses of drivers and risks of crop production, as well as associated socio-economic impacts. The GSAP project has demonstrated that subnational agricultural information, in the form of agricultural censuses and surveys, is widely available from the same national entities that annually report national figures to FAO. With the new capabilities enabled by this dataset, we can analyze global yield gaps and food security, discuss implications for rural development policies, and engage key institutions and potential users to promote its uptake by researchers and practitioners. This dataset can contribute to addressing one of the biggest societal uncertainties in the coming decades - the sustainability of increasing food production to feed a growing population that demands higher protein and calorie intake while facing mounting risks associated with water availability, climate change, alternative land uses, and unequal distribution of farmland and the world's population.

**Landscape Decision System through spatial modelling tools to ensure food security**

Theme 1: Securing food and nutrition within planetary boundaries

**Muhammad Naveed Arshad**[1]
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[3] University of Aberdeen, United Kingdom

**Abstract/Session concept note text:** Food security is a critical global issue, with increasing concerns due to population growth, urbanization, climate change, and land degradation. To address these challenges, effective on-farm decision is needed to support sustainable land use planning and management. Spatial modelling tools offer a powerful approach for analyzing and simulating landscape dynamics, and can be utilized to ensure food security by optimizing agricultural land use patterns, improving resource allocation, and reducing environmental impacts. Spatial modelling techniques, such as geographic information systems, remote sensing, and crop suitability modelling used to develop a landscape decision system having the ability to integrate multiple data sources, simulate landscape changes over time, and assess the impacts of different land use scenarios on food production. We emphasised the importance of incorporating socio-economic and environmental factors into the spatial modelling framework to account for the complex interactions between human activities and natural systems. The role of multi-criteria decision analysis in landscape decision system is also highlighted as critical elements for ensuring sustainable land use planning and management. There are some challenges and future directions of landscape decision system that include data availability, model validation, and scalability of the approaches. Future research directions are suggested, including the integration of advanced technologies such as machine learning and big data analytics to enhance the accuracy and efficiency of the system. In conclusion, landscape decision system has the potential to contribute to securing food and nutrition within planetary boundaries by supporting sustainable land use planning, minimizing environmental impacts, and informing evidence-based policy interventions.

# Panel 16 - Unlocking the Potential of the African Continental Free Trade Area for Fostering Inclusive Development and Sustainable Food Systems

**Unlocking the Potential of the African Continental Free Trade Area for Fostering Inclusive Development and Sustainable Food Systems**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Assem Abu Hatab**[1]
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**Abstract/Session concept note text:** Over the last three years, the concurrence and severity of external shocks, caused by the Covid-19 pandemic, the Russian aggression in Ukraine, and the negative effects of climate change and natural disasters, have exposed the vulnerability and fragility of African food systems. As a result, researchers and policymakers in Africa are now grappling with crucial questions regarding how the food systems can build back better, and how they can be shaped to contribute to prevent and deal with crisis, and adapt to change and new challenges without compromising the goal of securing the access to healthy food in the long-term. The African Continental Free Trade Area (AfCFTA), which came into effect in 2019, holds tremendous potential for transforming African food systems. It is considered a potential game changer as it enables African countries to strengthen and diversify their productive capacities, enhance intra-African trade in agricultural commodities and services, create market and investment opportunities for smallholder farmers and agrifood enterprises, reduce dependence on global value chains, and enhance the resilience of food systems against future shocks. However, the successful implementation of the AfCFTA is not guaranteed. To translate AfCFTA's potential into tangible development outcomes, it is crucial to combine political will and adequate capacity with trade and agricultural policies and structural reforms that promote sustainable agricultural productivity to better leverage existing comparative advantage. This also requires targeted social programs, training initiatives to facilitate labor mobility across industries, and employment promotion.

The planned workshop aims to bring together participants who work on regional trade integration and food systems from a range of perspectives–government, NGO, civil society, donors and research–to reflect and exchange views on ways and means to fully harness the potentials of the AfCFTA to support inclusive socio-economic development on the continent, mainly through enhancing the resilience of African food systems. The theme of the workshop resonates with the designation by the African Union of 2023 as the year of "Acceleration of African Continental Free Trade Agreement (AfCFTA) Implementation" as a manifestation of Africa's strong commitment to advancing the AfCFTA and harnessing its full developmental impact.

## Panel 17 - Smallholders attitude toward food and agro-productions

**Agricultural biologicals in sub-Saharan Africa: smallholder farmers' perspectives**

Theme 1: Securing food and nutrition within planetary boundaries

**Mesia ILOMO**[1, 2]
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[4] Kotebe Metropolitan University
[5] Agricultural Research Council
[6] Swedish University of Agricultural Sciences

**Abstract/Session concept note text:** This paper maps the research and use of agricultural biologicals in sub-Saharan Africa from a smallholder farmers' perspective. It includes a cross-country knowledge, attitude, and practices (KAP) analysis. We document the regulatory framework on agricultural biologicals in the region. It is based on policy documents reviews, systematic mapping of existing literature, and interviews with 23 policymakers, regulators, and biologicals companies as well as surveys of 600 smallholder farmers' and 115 agro-dealers conducted in Ethiopia, Kenya, and South Africa, and online survey of 120 subject-area specific researchers. The results show limited research output on agricultural biologicals in sub-Saharan Africa, which was largely dominated by lab research and academic publications. As for types of biologicals, much of the research focuses on bio-pesticides and bio-controls, and less on bio-stimulants and resistance inducers. We found limited awareness among smallholder farmers in sub-Saharan Africa, albeit some variations between countries. Also, we found biologicals companies reluctant to serve smallholder farmers due to logistical challenges and absence of incentives and economies of scale. Further, there are limited number of biologicals products in sub-Saharan Africa with few suppliers, which can impede a shift to biologicals. For food security and safe livelihoods, interviewed stakeholders recommend biologicals as part of integrated pest management and not as sole solution to challenges facing smallholder farming in sub-Saharan Africa. While noting the progress in regulating biologicals, we found gaps in both policymaking and implementation. Nonetheless, we note the potential for strengthening government-university-industry interactions and South-South cooperation in guiding the regional development of biologicals.

**Assessment of smallholder farmers' knowledge, attitude and practice on use of agricultural biologicals in Kenya**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** Agricultural biologicals are touted as sustainable and environmentally friendly alternatives for management of pests and diseases. Their use, especially in Sub-Saharan Africa, is limited as compared to other parts of the world. This study assessed the Knowledge, Attitude and Practice among small-holder farmers in Kenya on the use of agricultural biologicals. The study involved 275 farmers in Kajiado, Kiambu and Machakos counties. The majority of farmers (76%) had relevant knowledge on agricultural biologicals in all the three counties even though some of the inputs they referred to as biologicals are not biologicals in true sense. The majority (76%) of the farmers were not trained on agricultural biologicals. Almost half of the farmers in the three counties (40%) obtained information on biologicals from neighbours while agro-dealers were key advisors to farmers on agricultural inputs. Kajiado had the highest level of farmers (47%) who reported using biologicals. Knowledge and attitude did differ significantly (P=0.01) across the 3 counties. However, there was significant variation in practices. There was a strong association between age and education as well as knowledge. Years of farming also positively influenced knowledge on agricultural biologicals but not attitude and practice. Farmers who had spent many years farming, had more knowledge on biologicals. The results of the study also showed that having sufficient knowledge on agricultural biologicals biological did not translate to good practices. This means that knowledge on biological alone is not sufficient to ensure the use of biological among smallholder farmers in Kenya.

**Key words**

Agricultural biologicals**,** smallholder farmers, knowledge, challenges, Sub-Saharan Africa.

**Mapping response interactions to deal with coalescing changes in a South African food value chain**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** Value chain actors linking producers to consumers face the need to respond to the multiple, coalescing changes affecting food systems. For instance, agricultural systems face environmental changes (e.g., droughts, weather changes), social conflicts (e.g., protests) or economic shocks emerging from both national and global scales. Here, we investigated how different types of actors across the value chain of deciduous fruit in the Western Cape, South Africa, which reaches both national and global markets, respond to such multiple changes. We identified different types of responses, including responses at the farm level and responses that are based on social relationships and networks amongst diverse actors. For example, such networks include knowledge exchange or collaboration between producers, packaging houses and exporters, having limited participation of informal market actors liked to local markets. In addition to identifying different types of responses to changes and their associated social networks, we use a complex adaptive systems framework to conceptualize and analyze response interactions. We explore how response interactions may contribute to the emergence of a system-level pathway characterized by an intensified export-based agricultural production system. We hypothesize how these interactions and the associated outcomes are influenced by social networks that are used in responding to changes, with important consequences for the development of food systems in sustainable pathways. Such system-based understanding of response interactions within value chains facing coalescing changes is key to foster transdisciplinary discussions regarding the mechanism that drive (or hinder) food systems' development towards resilient and desirable pathways.

**Keywords:** value chains, responses, networks

**Knowledge, attitude, and practices (KAP) of smallholder farmers on agricultural inputs with a focus on biologicals**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** There is a drive to reduce pesticide use due to the negative effects pesticides have on the environment and human health. Thus, countries are reduction usage of hazardous chemical pesticides. The lack of sustainable agri-inputs and safety precautions when applying pesticides are not always followed among smallholder farmers in low-income countries. This necessitates low-risk crop protection strategies such as agricultural biologicals. The market and use of biologicals are limited in sub-Saharan Africa. To understand the reason behind, this study examined knowledge, attitudes, and practices towards agri-inputs with a focus on biologicals among 150 smallholder farmers in the Chole district in Ethiopia. All farmers used chemical pesticides and/or inorganic fertilizers to protect crops, improve yield, and comply with government regulations. Regarding the practice of using biologicals, it was restricted to one group of biologicals, bio-fertilizer, which about 60% of farmers used, whereas no usage of biologicals for plant protection was reported. Even though the understanding of the concept of biologicals was deemed high among respondents, the majority (90%) did not identify biologicals as safer alternatives to conventional agri-inputs. More than half of the respondents (54%) did not recommend biologicals as a safer alternative to their colleagues. Though farmers did not perceive biologicals as risk-free, they had a positive attitude towards biologicals when it came to producing healthy food and increasing crop yield and income. In comparison to the positive attitude, the farmers' knowledge and practice of biologicals were in general low; thus, efforts are needed to create awareness among farmers.

***Keywords***: agricultural inputs, biologicals, biostimulants, biofertilizers, biopesticides, Knowledge Attitude and Practice (KAP), Sub-Saharan Africa, smallholder farmers

## Panel 18 - Renewable energy and supply chains

**Biochar from cookstoves: Farmer-led French bean trials from smallholder farmers in Rwanda**

Theme 1: Securing food and nutrition within planetary boundaries

**Uwingabire Solange**[1]
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**Abstract/Session concept note text:** Biochar produced in TLUD cookstoves has the potential to contribute to increasing carbon sequestration, access to clean renewable energy, and increased yields in tropical agriculture. The aim of the reported research was to estimate effects on food production, from the introduction of biochar-producing cookstoves on smallholder farms in Rwanda. Participatory research on biochar production and use in kitchen gardens was undertaken with 60 Rwandan smallholder-farming households. Biochar application in furrows (2-3 cm deep) in farmer-managed planned comparison plots of 10-20 $m^2$ and biochar application rates were determined by amounts produced and saved by households. Based on collected data, Cookstoves provided benefits through reduced smoke, fuel wood savings, and biochar production. On-farm trials with varying rates of biochar inputs have led to a sustained increase of French bean yields following one-time application. Climate benefits from biochar production and use are thus possible on smallholder farms in Rwanda through reduced use of biomass in cooking, reduced emissions of products of incomplete combustion, sustaining soil health, and sequestration of stable biochar carbon in soils. The use of gasifier stoves will enhance energy efficiency and reduce women's and children's burden while improving their health. The adoption of agroforestry will increase biomass availability and this could result in an extra source of income for project beneficiaries and improve their living conditions. Biochar application will reduce the high demand for lime due to increased soil pH and it will enhance C sequestration and will improve soil structure hence reducing the high demand for inorganic fertilizer. Finally, a high yield of vegetables among smallholder will reduce malnutrition and stunting among smallholder farmers.

**Keywords**: TLUD stoves, soil fertility, biomass production, Biochar production, and vegetable production

**Enhancing Resilience: Multi-Scale Network Analysis in the Integration of the Land Perspective within the Water-Energy-Food Nexus**

Theme 1: Securing food and nutrition within planetary boundaries

**Jorge Marco**[1]
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**Abstract/Session concept note text:** This paper illustrates the importance of incorporating the land perspective (L) into Water-Energy-Food (WEF) nexus approaches. While the WEF nexus has received attention as a means to achieve interdependent sustainable development goals, several studies show that interactions among its nexus elements are context-specific and strongly influenced by land use changes. We propose a novel analytical framework to establish the extent to which land use changes impact the composition and resilience of the WELF nexus. We hypothesized that, by maximizing resilience, policymakers can design more effective and targeted policies for achieving long-term sustainable development goals. This is because greater resilience improves the capacity of land use systems to manage uncertainties and recover from disruptions like climate change or political instability. Our framework is applied to the region of Maria La Baja, a sub-watershed located in the Colombian Caribbean. The results show that the WELF nexus manifests differently across different spatial scales, wherein Food (agriculture) consistently emerges as a crucial factor in maximizing resilience. The significance of other nexus elements like Energy and Water varies considerably depending on the scale of analysis. Other factors like abandonment of agricultural lands or increased deforestation play a key role in determining resilience at sub-regional scales. Finally, we identify which land use policies can be most effective in maximizing resilience.

**Renewable Energy-Powering Food Value Chains**

Theme 1: Securing food and nutrition within planetary boundaries

**Mweetwa Sikamikami**[1]
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**Abstract/Session concept note text:** This Abstracts objective is to evaluate and pinpoint workable decentralized solar PV technologies that can power crucial food value chains that are shared by all of the southern African developing nations (SADC). The ongoing behaviors and the nodal energy input sites that may power important processes inside these value chains are reflected in survey-driven data from Zambia and research based on these data. Due to its predominance indomestic cooking and usage as a backup or secondary fuel (a practice known as"fuel stacking"), charcoal is a major cause of deforestation and forest degradation in Zambia. More than 75% of Zambians in peri-urban and urban areas, regardless of income, use charcoal as their primary choice for home cooking needs because it is widely accessible, inexpensive, and culturally acceptable. Charcoal is still preferred less and used less as incomes rise, although it is still utilized in conjunction with other fuels like electricity. It is note worthy that a majority of urban households, including those with high incomes, report using charcoal on a daily basis (60%); this refutes the notion that charcoal is primarily used and favored by low and middle-income households and shows just how widely accepted charcoal is as the preferred fuel.
The objective is to develop techniques that, by utilizing renewable resources like solar power, enable mechanization that is efficient, innovative, and climate resilient.

**Deforestation-free cocoa production in Ghana: Future pathways for a new division of roles and responsibilities in the global cocoa-chocolate chain**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Franziska Ollendorf**[1]
Kwabena Buabeng[1], Katharina Löhr[1], Stefan Sieber[1]
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**Abstract/Session concept note text:** In the context of the global cocoa-chocolate value chain (GCCC), this contribution examines stakeholder perspectives on potentially changing responsibilities of economic actors linked to the introduction of the EU Regulation on Deforestation-Free Products, scheduled for mid-2024. The Regulation sets out a number of binding obligations for all companies placing products associated with deforestation for the first time on the EU market. New obligations can be clustered into three main fields of action: due diligence, supply chain risk assessment, and the implementation of mitigation measures.

Taking the case of the cocoa sector in Ghana, the contribution seeks to assess current stakeholder perspectives on possible main challenges with the implementation and potential effects of the Regulation. The two main research questions are as follows: 1) What are the potential effects of the Regulation on the governance constellation in Ghana's cocoa sector? 2) How may the Regulation affect cocoa farmers in the high-risk areas of the country? Based on 17 key-informant interviews with a broad range of actors in the Ghanaian cocoa and German chocolate sectors, and an interpretation of results based on Scenario Building tools, the study carves out two opposing developmental pathways, that is a fully privatized cocoa sustainability system on the one hand, and the establishment of a functional public Cocoa Management System in Ghana on the other hand. The possible implications of both systems are discussed for the levels of cocoa farmers, the Ghanaian cocoa sector, and general tendencies in the GCCC.

## Panel 19 - Agricultural production

**Valuable Soils and Minimised Chemical Fertiliser Content Analysis in Arid Regions of Gujarat**

Theme 1: Securing food and nutrition within planetary boundaries

**Diwakar Kumar**[1]
[1] central university of Gujarat

**Abstract/Session concept note text:** A sufficient agricultural expansion is necessary for inclusive growth, which takes into account a decrease in poverty rates, the expansion of the rural sector, and an increase in agricultural earnings in rural India. An agricultural expansion of about 4% is needed to achieve the country's much-desired double-digit GDP growth. The inclusive growth can only be achieved when agricultural output picks up speed and is evenly distributed among the nation's population and geographic regions. Reforms to improve soil health must therefore continue to dominate the policy agenda. It is essential to continuously assess how the policy is being implemented in order to spot any bottlenecks and put in place the right rules that will allow the distribution of soil health cards to be expanded across the country. There are a number of elements that must be determined and handled in light of the socioeconomic circumstances of Gujarat's distant villages in order to increase the state's Soil Health Card's acceptance among farmers and authenticity in relation to the testing parameters. The purpose of this project is to look at the possibility of using less fertiliser while enhancing agronomic productivity by creating more productive soils. For Gujarat's dry regions, this sustainable management strategy is particularly pertinent. This study presents an overview of Anand Agricultural University and its participation in the implementation of soil health card distribution status in Gujarat state using primary and secondary data acquired from multiple published sources and interviews of several stakeholders. The findings have produced problems that are important to policy as well as suggestions for improving the use of soil health cards.

**REIMAGINING THE CULTURAL LANDSCAPE OF Oryza sativa L. (POKKALI RICE)**

Theme 2: Governance and rights in food systems: Leaving no one behind

**HAJARA HILAL YUSUF**[1]
[1] SCHOOL OF PLANNING & ARCHITECTURE, BHOPAL

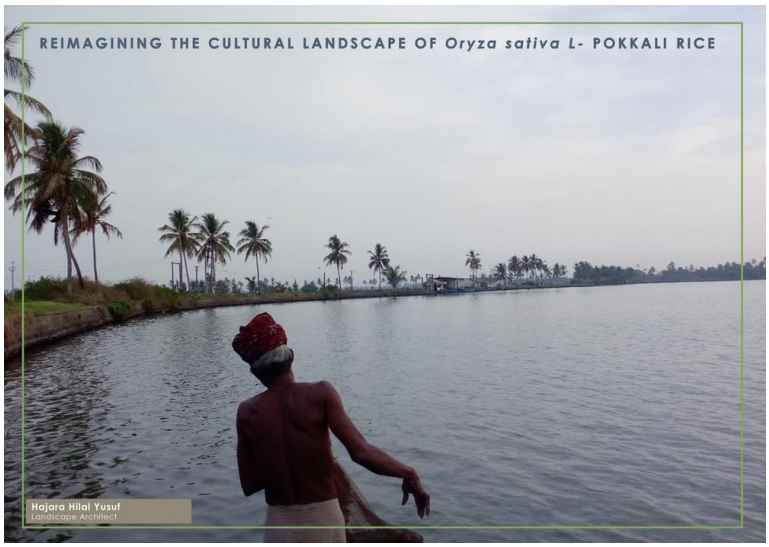
**Abstract/Session concept note text:** Kerala has been experiencing recurring floods for the past five years and farmers are most affected by this as they not only lose their homes but also their source of livelihood, agriculture. It is essential hence to delve deep into the forgotten past of agriculture and look for self-sustained methods of farming wherein the farmers can survive nature's aggression.

Pokkali farming, a farming method that originated almost 3000 years ago is a flood resilient, saline resistant variety of rice grown in the Central coastal tract of Kerala. This farming is an important part of Kudumbi community's identity whose culture is fast being dissolved.

The farming method is an independent model that does not need external fertilizers as it is done with shrimp farming. The first six months starting from April, Pokkali farming is done followed by shrimp farming in the next six months. The leftover stalks after harvest of Pokkali serves as food for shrimps and the excreta of the shrimps serve as manure for the Pokkali farming.

The site chosen was in Goshree Island, Ernakulam district, which was found to be most apt for Pokkali cultivation after analysis of various cultural and natural layers. There are many reasons for the downfall of Pokkali from dependence on manual labor as it grows in water, insufficient profit for farmers to breaching of the Pokkali farms. Revival of Pokkali rice can be done by proposing suitable Landscape strategies which will restore its place in the society.

Keywords: *Pokkali Rice, Flood resilient, Salt tolerant, Kudumbi Community, Biodiversity hotspot*



**Seed Village Programme for food sovereignty: A success story from arid zone**

Theme 2: Governance and rights in food systems: Leaving no one behind

**Dheeraj Singh**
Chandan Kumar[1], A.S. Tetarwal[1], B R Kuri[1], MAHENDRA CHOUDHARY[1]
[1] ICAR-CAZRI, KVK Pali

**Abstract/Session concept note text:** The key element for maximising potential yield is high-quality seed, however despite the structured seed program's implementation, a significant gap exists between the supply and demand for high-quality seeds. An increase in the availability of high-quality seeds from new, varieties will significantly increase the productivity and output of these crops. Krishi Vigyan Kendra began the seed village programme in its targeted villages during 2020–22 considering the above-mentioned details in reference. As a result of this, the they provided high-quality seeds of improved varieties for four vital local crops Wheat, Barley, Mustard and Cumin to the area's designated farmers in accordance with an annual schedule. The concept of a "seed village," which would encourage regional authority over the production and supply of high-quality seeds was exploited. In order to empower farmers with technology, multiple training sessions on seed production technologies were scheduled for the identified farmers in the seed villages. These farmers underwent training on isolation distance, planting techniques, seed treatment, off type plants, and other agronomic practices. Construction of farmers' capacity was given specific priority in order to maximise the synergy between technology and community involvement. The farmers employed these high-quality seeds and multiplied them on their own in the working area, which resulted in a significant spread of better variety in neighbouring villages. Thus, there is a huge opportunity to create and distribute high-quality seed for the majority of crops. For this the seed village concept, a cutting-edge and very practical method, needs to be pushed.

**Contribution of Hot Pepper Production to Household Food Security and Income Generation in Gursum District, Oromia Regional State, Ethiopia**

Theme 1: Securing food and nutrition within planetary boundaries

**Ibsa Aliyi Usmane**[1]
[1] Haramaya University, School of Rural Development and Agricultural innovations

**Abstract/Session concept note text:** Food insecurity is the key policy challenge for Ethiopia in general and Gursum district in particular. To combat this problem diversifying the smallholders' farming systems and income sources is an option. In this regards, the production of cash crops like hot pepper, groundnut and other market-oriented crops is indispensable. Although hot pepper production is important source of income of households, systematic and rigors analysis of its contribution to households' food security has not been done in Gursum district. Thus, this research was undertaken in Gursum district of Oromia regional state in two kebeles with the objectives of examining food security status of household, analyzing the contribution of hot pepper in household food security and identifying the factors affecting household food security and hot pepper production. The research used primary data generated from 150 randomly selected sample households and secondary data from secondary sources. Household calorie consumption method was used to identify food security status of the sample household. The collected data were analyzed by using descriptive statistics like mean, standard deviation, frequency and percentage. The chisquare(X2) test for systematic association of discrete/dummy variables with food security status and t-test for mean difference of continuous variables for food secure and food insecure households were used. Binary logit model was used to identify the factors affecting household food security in the study area. Among twelve hypothesized variables five were significantly affect food security status of the household those were household size at $p<5\%$, land size at $p<1\%$, level of education at $p<5\%$, non-farm participation and income from hot pepper at $p<1\%$ probability level. In general from the empirical analysis, similar to other studies on income from cash crop has contribution for food security, thus, this study also confirms that income from hot pepper has significant contribution in improving food security status of the household. But low price, lack of improved and other constraints challenges the production of hot pepper. Therefore, local government, both local and international Nongovernment Organizations and other stakeholders should jointly work on hot pepper production and its income to improve food security of household.

Keywords: Food, Hot-Pepper, Binary Logit

## Guided poster walks Day 3

**Enhancing Food Security through Climate-Smart-Agricultural Practices: Micro-Economic-level Evidence from Smallholder maize farmers in South Africa**

Theme 1: Securing food and nutrition within planetary boundaries

**Abeeb Omotoso**
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**Abstract/Session concept note text:** Despite the high contribution of the agricultural sector to the overall economy development, this sector has been facing challenges of many factors of which climate-related disasters like drought and floods are the major ones. The study aimed to examine the effect of climate-smart agricultural (CSA) practices on food insecurity indices of smallholder maize farmers in South Africa. A multi-stage sampling technique was employed in selecting smallholder maize farmers across 12 villages in the North West province, South Africa. The results revealed that the majority (80.0%) of the respondents were married, while mean age, household size and farm size were 48.5 years, 6 persons and 4.2 hectares respectively. Mixed cropping was the most practiced CSA in the study area, and 55.5% of the farming households were food insecure, while 44.5% were food secure. The depth of food insecurity and severe food insecurity among the sampled farming households were 0.1621 and 0.0516 respectively. The Probit regression result showed that the food security status of the rural farming households is significantly affected by age of the household head, farm size, off-farm income, household size and CSA practice. The study concluded that household food security status in South Africa are being influenced by the adoption of CSA practices and other socioeconomic factors such as age, household size, off-farm income, and gender as additional determinant. The study recommends that government and the concerned stakeholders should promote and encourage the adoption of CSA to ensure agricultural sustainability in agrarian communities.

Keywords: Climate-smart; Food shortage; Household Dietary Diversity Score; Mixed cropping; Probit regression;

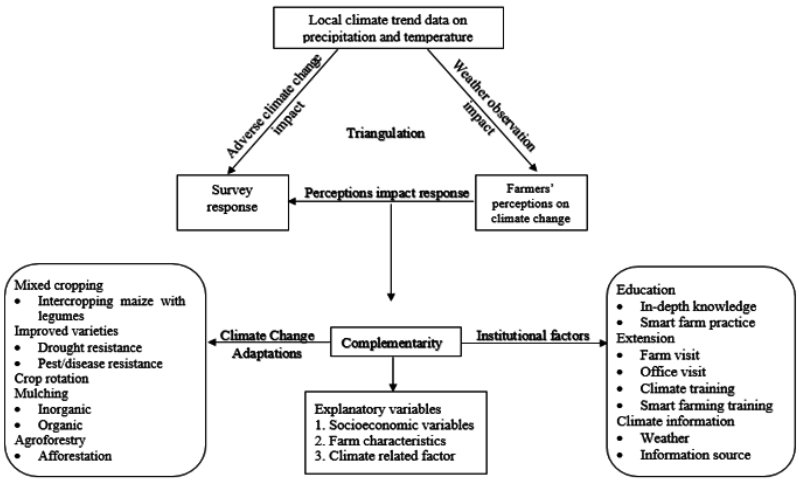


**Figure 1.** Conceptual model of triangulation and complementarity between CCAS and institutional factors.

**Biofortification of Cereals Based Bread Using Orange Fleshed Sweet Potato for Alleviating of Vitamin-A Deficiency**

Theme 1: Securing food and nutrition within planetary boundaries

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[2] Addis Ababa University

**Abstract/Session concept note text:** *Ethiopia is one of the developing countries with a high prevalence of micronutrient deficiencies and protein-energy malnutrition. Vitamin A is one of the most versatile vitamins with roles in various functions such as vision, immune defense, maintenance of body linings and skin. Fortifying cereals through processing and conventional breeding can tackle micronutrient deficiency. Orange Fleshed Sweet Potato (OFSP) is a source of food that contains useful β-carotene, starch, mineral, dietary fiber, and vitamins. The inclusion of OFSP enhances the beta-carotene content of bread. This research aims to develop Vitamin A rich cereals based bread enhanced with orange-fleshed sweet potato. The straight dough baking method was used to develop bread. Beta-carotene content and physical properties of bread were done based on standard methods. Blending of OFSP flour in cereals significantly influenced the physical properties of bread. The total carotenoid content of bread products with 10% of OFSP Flour was 3.998mg/100g while that of beta-carotene is 23.217mg/100g. Inclusion of OFSP in composite flour increased the total carotenoid and beta-carotene content of bread. Generally, formulated flour has huge advantageous as a means of enhancing beta-carotene content and helps to alleviate vitamin A deficiency.*

**Potential Opportunity in the Cassava value chain:A Nigeria case study**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** Smallholder farmers are the main producers of cassava; they have limited access to mechanization, employ low-quality inputs, and poor agronomic methods. Nigeria's present output of 8.2MT/ha has been greatly influenced by this, as compared to a potential production of 20-30MT/ha with the use of mechanization and sound agronomic methods. Using conventional food processing techniques, the majority of the cassava produced is turned into regional foods like fufu and gari. Demand for regional food products made from cassava puts pressure on the industrial processing landscape from the traditional food processing sector. But thanks to the efforts of FMCGs, the market for industrial goods like starch, flour, and ethanol is expanding.

Several constraints exist along the cassava value chain, limiting the crop's potential for income and food security. Given how heavy and voluminous cassava roots are, transportation from farms to processing facilities is expensive. Smallholder farmers that supply industrial processors with their cassava varieties typically grow these crops with a low starch content of 20% or less on average. The lengthy time of conventional cassava stem multiplication methods prevents farmers from easily accessing the improved varieties of cassava that research institutes have developed.

The productivity of smallholder cassava farmers will rise along with adoption rates of improved seed and production mechanization, resulting in a thriving cassava industry. African smallholder farmers will be in a better position to maximize their cassava production and raise their revenue by using improved varieties and high-quality cassava stems if their seed system is economically and commercially viable.

**Keywords:** Cassava, Value chain, Starch, Smallholder farmers, Industrial processing

**Backyard garden contribution to the food security status of urban households**

Theme 1: Securing food and nutrition within planetary boundaries

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**Chiedza L. Muchopa (PhD)**[1]
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**Abstract/Session concept note text:** Sufficient food production is increasingly challenged in the midst of economic, social and environmental pressures to which end backyard gardens are an important and considered a resilient food security source for urban households. An important aspect to achieve the goal of ending hunger (SDG2) is to understand the household food security status of urban households as well the contribution of backyard gardening to their food security status. This paper uses the widely accepted Household Food Insecurity Access Scale to assess the food security status of a small sample of purposively selected households in an urban township. A contribution index is then calculated to quantify the contribution of backyard gardening to household food security also delineated according to household size. Further, a logistic regression model is used to analyse the factors affecting the food security status of those selected households practising backyard gardening. The results from the analysis show that the size of the household, the household head's employment status, farming experience and frequency of harvest from the backyard garden are significant factors affecting the urban household's food security status. This study sheds some light on household specific factors that could be important in policy targeted interventions towards the attainment of SDG2.

**Rotavirus Genotypes Circulating in Calves and Children in Central Ethiopia**

Theme 1: Securing food and nutrition within planetary boundaries

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Tesfaye Sisay Tesema[1], Haileeyesus Adamu[1], Johanna Lindahl[2], Anne-Lie Blomström[2], Mikael Berg[2]
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**Abstract/Session concept note text: Background**: Rotaviruses have been recognized as important agents of acute diarrhea in both humans and animals. Nearly half a million children die from rotavirus infections each year worldwide including Ethiopia. Rotavirus are characterized by a high mutation and reassortment rate, which makes host jumping and cross-species transmission easy. The role of bovine rotavirus genotypes as a source of human infections has not been studied in Ethiopia. Therefore, it is necessary to investigate the distribution of various genotypes of rotavirus in both bovine and humans in the country.

**Materials and methods**: Fecal samples were collected from diarrheic calves (< 6 months) and stool specimens from diarrheal patients (children < 5 years) from central Ethiopia. RNA-PAGE and real-time PCR were used to detect the rotaviral genome. Sequence analysis of the VP7 and VP4 genes of rotavirus were performed to determine the circulating genotype.

**Result**: A total of 6% (12/195) rotavirus positive samples were identified from diarrheic children and 3% (3/96) from bovine calf diarrheic samples. The different genotypes of rotaviruses that are circulating in children in central Ethiopia are G1P8 (33.3%), G9P4 (33.3%), G9P6(8.3%), G6P9(8.3%), G12P6(8.3%) and G1P6(8.3%).70% of the isolates do not match with the current vaccinal strain Rotarix (G1P8).

**Conclusion**: The detection of heterogeneous rotaviruses in this study highlights the need for extended studies to describe the burden and genetic diversity of rotavirus in the country.

**Keywords:** central Ethiopia; diarrhea; bovine rotaviruses; human rotavirus

**Impact of climate change on management practices of maize: case of Mount Makulu, Zambia**

Theme 1: Securing food and nutrition within planetary boundaries

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Edson Nkonde[2], Elijah Phiri[3], Miyanda Moombe[3]
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[3] University of Zambia

**Abstract/Session concept note text:** Simulating crop yield and yield variability requires long-term, high-quality weather data such as rainfall, temperature and solar radiation data. A field experiment conducted at Mount Makulu was used to simulate the interactive effect of sowing dates (SD1, SD2, SD3), maize cultivars (PIO30G19, PIO30B50, ZMS606), and nitrogen application rates (N1 = 66; N2 = 132; N3 = 198 kg N $ha^{-1}$) on strategic and economic assessment. Statistical downscaled climate datasets from three Global Climate Models (GCMs) for the period 1971-2000, 2010-2039, 2040-2069, 2070-2099 under two Representative Concentration Pathways (RCP4.5, RCP8.5) were used as input into the DSSAT v4.7, Seasonal Analysis Program to predict the impact of climate change on maize yield. Results show higher increase in temperature while rainfall exhibits variability. The biophysical analysis showed varied grain yield responses to SD, maize cultivars and N application rates. The Mean-Gini analysis showed that PIO30B50 had an efficient late sowing date (SD3) with an application of 132 and 168 kg N $ha^{-1}$ under RCP4.5 and RCP8.5. Further, PIO30G19 at SD3 with 198 kg N $ha^{-1}$ would be the most dominant management option for maize grain yield under future climate scenarios from 2010-2099. To increase grain yield under future climate scenarios, the adaptation strategies that should be implemented are varying sowing dates, adopting late-maturing cultivars with longer growth period, and breeding cultivars with high thermal time requirements.

**Crop Yield Perdition in a Heterogeneous Agricultural Region using Remote Sensing Images and Machine Learning Algorithm**

Theme 1: Securing food and nutrition within planetary boundaries

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**Abstract/Session concept note text:** Crop yield estimation is a significant problem in crop monitoring and is still difficult in developing nations because of the lack of timely and adequate data. While traditional agricultural systems primarily rely on limited ground-survey data, freely accessible multi-temporal and multi-spectral remote sensing images are excellent tools to support these weak systems by accurately monitoring and estimating crop yields before harvest. Here, we introduce a method for estimating rice crop yields in the North-West region of Bangladesh using Sentinel-2 imagery with medium spatial and temporal resolution. Initially, we created a satellite based large scale rice crop database using spectral bands of multi-temporal images, vegetation indices, and climate information for the study area. Second, we developed a robust Machine Learning based methodology capable of predicting rice crop yield with high precision. Finally, we investigated the importance of different vegetation indices, spectral bands, and different climatic parameters in different configurations on the performance of the suggested approach and machine learning based yield estimation techniques. The results demonstrated that using three spectral bands and two vegetation indices from Sentinel-2 imagery best predicted rice yields. This model achieved high accuracy with a low normalized root mean square error (RMSE) ranging from 500 to 700 kg/ha for different test fields. We hoped that the prediction model could be used to provide early warnings of potential yield losses. Therefore, farmers can take measures to protect their crops and minimize the impact of climate variability. This may involve modifying planting dates, selecting more resilient crop varieties, and implementing irrigation or other methods of water management.

**Keywords:** Crop yield prediction, Feature importance, Machine Learning, Climate Variability, Vegetation indices.

**GENETIC DIVERSITY IN OLD AND ALIEN WHEAT GENOTYPES FOR NUTRITIONALLY IMPORTANT TRAITS.**

Theme 1: Securing food and nutrition within planetary boundaries

**Olawale Jubril Olalekan**[1]
Mahbubjon Rahmatov[1], Elaine Ceresino[1], Eva Johansson[1]
[1] Swedish University of Agricultural Sciences (SLU)

**Abstract/Session concept note text:** Wheat is an important staple crop that is grown and consumed around the world. It is a major source of calories, protein, vitamins, and minerals in many homes, contributing micronutrients to diets. Breeding micronutrient-dense staple crops is a powerful strategy to address global undernutrition and malnutrition. Wild crop relatives is an important source that can be used to introduce valuable genetic diversity to elite wheat cultivars to improve their nutritional value. This study assesses the protein and mineral content variation in a genetically diverse set of wheat consisting of 341 genotypes of groups A to D. Analysis of variance (ANOVA) revealed a significant effect ($P<0.01$) of the genotypes on all analysed protein-related traits. High protein, iron and zinc content, combined with low cadmium content, were recorded in many genotypes in groups C and D with low gluten strength with performers in genotypes SW336 and SW 346. Conversely, groups A and B show high Fe, Zn and gluten strength content with lower protein content and higher cadmium, with genotypes Kr08-126 and Sw292 being top performers. The study demonstrates ample genetic variability in old and wild relatives of wheat for protein content, gluten strength, and minerals, which can be harnessed for improving wheat nutrition and protein functionality through breeding programs. The findings of this study will result in a search for the genes of nutritional traits of interest to introduce into elite cultivars to enhance the nutritional benefits and combat nutritional deficiency.

## Panel 20 - Food systems in the face of climate and exogenous shocks: Building back better for increased resilience

**Food systems in the face of climate and exogenous shocks: Building back better for increased resilience**

Theme 1: Securing food and nutrition within planetary boundaries

**Enock Owusu-Sekyere**

**Abstract/Session concept note text:** Over the last three years, the concurrence and severity of exogenous shocks, caused by the negative effects of climate change and natural disasters, the Covid-19 pandemic, and geopolitical conflicts, have exposed the vulnerability and fragility of food systems. The concept of resilience has come to the attention of policy makers in Sweden and South Africa, asking how food systems can build back better, how they can be shaped to contribute to prevent and deal with crisis, protect the people and the environment, and adapt to change and new challenges without compromising the goal of securing the access to healthy food in the long-term. The planned workshop aims to bring together participants who work on climate and environmental changes, food systems, and food security issues from a range of perspectives–government, NGO, civil society, donors and research–to discuss policy options and define research priorities for building more resilient food systems.
More specifically, the session is planned to achieve the following two objectives: (i) Exchange knowledge, best practice and views on building resilience of food systems and enhancing the capacity of national food systems to prepare, absorb, mitigate and adapt to shocks and stresses. (ii) Share perspectives on elements for policy frameworks to make food systems more efficient, sustainable, and inclusive, and to minimize trade-offs as we develop policies to enhance food supply chain resilience in the face of disruption.

***Keywords:*** *Climate risks, exogenous shocks, resilience, food systems*

***Speakers*****:** Dr Enoch Owusu-Sekyere* (Dept. of Economics, Swedish University of Agricultural Sciences, Uppsala, Sweden); Assoc. Prof Paul A. Egan (Dept. of Plant Protection Biology, Swedish University of Agricultural Sciences, Uppsala, Sweden); Prof Abiodun Ogundeji (Disaster Management Training and Education Centre for Africa (DiMTEC), University of the Free State, South Africa); Prof Assem Abu Hatab (Swedish University of Agricultural Sciences, Uppsala, Sweden, Nordic Africa Institute (NAI), Uppsala); Dr Kate Longley (Catholic Relief Services).

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# Panel 21 - Pest and sanitation

**Screening and Evaluating Potential Lactic Acid Bacterial from Cambodian fermented vegetables**

Theme 1: Securing food and nutrition within planetary boundaries

**SIVLIN UNG**[1, 2]
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**Abstract/Session concept note text:** Probiotic draw much attention lately in biotechnology industry due to its positive effect to the host with the right dosage. Fermented food is the major source of probiotic bacterial including lactic acid bacteria (LAB). Various types of fermented foods were consumed by local Cambodian, however, little known about LAB and its role in food. This study aims to screen for significant LAB stains with antimicrobial activity and immunological inducer properties from local fermented vegetables in Cambodia. Total 96 fermented vegetable samples were collected from 04 difference fermented vegetables including Green mustard, Cucumber, Spider flower and Papaya fermented. Culture base method was performed for the isolation of LAB, and confirmed with gram staining and catalase test. pH lower than 5.5 were screened for LAB isolates with antibacterial activities. As a result, 12 out of 141 aerobic isolates showed broad antagonistic against *E. coli* O157 Sakai, *S.* Typhimurium, *S. aureus* (MRSA) and *L. monocytogenes*, while 28 out of 78 anaerobic isolates showed antimicrobial activity against *S. aureus* (MRSA). Furthermore, hemolysis test was conducted on all these potential antimicrobial activity isolates, which 39 isolates showed gamma hemolysis (no red blood cells lysis activity), and 01 isolate show alpha hemolysis (partially lyse the red blood cells). These results likely proofed that selected isolates could be best probiotic candidates as the started culture for down stream application in fermented vegetable products. Further study, those potential isolates will be selected for gastrointestinal tolerance, species identification, antibiotic susceptibility test, auto and co-aggregation, and immune effect test.

**Prevalence of Salmonella spp. in meat and leafy green vegetable from local market and vegetable farms in Phnom Penh, Cambodia**

Theme 1: Securing food and nutrition within planetary boundaries

**Laingshun Huoy**[1, 2, 3, 4]
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**Abstract/Session concept note text:** *Salmonella* is one of the major bacterial public health concerns in the world. In Cambodia, there are few published reports on the prevalence of *Salmonella* spp. along the food chain, but several reports show that salmonellosis is a serious gastrointestinal illness in humans, particularly among children. This study aimed to investigate occurrence of *Salmonella* spp. in meat, sea food and leafy green vegetable collected from different local markets in Phnom Penh, and on farms close to Phnom Pehn, Cambodia, during the period November 2020-November, 2021. Total 285 food samples have been randomly collected; of those were 125 from meat and 160 from leafy green vegetable. Culture method were used for bacterial isolation from each sample, and confirmed with biochemical test, serological, and PCR detection of invA gene. The overall prevalence of *Salmonella* spp. was 49.5% (141/285). Total 134 isolates were classified into 6 serogrouping including serogroup A, B, C, D, E, and G, while 7 isolates were unclassified. The results suggest that majority large part of meat and vegetables sold at selected local markets in Phnom Penh are contaminated with *Salmonella* spp. Likely this can be linked to the hygiene and sanitation practices at local markets, and also conditions of handling, storage and preservation process. In addition, farm result showed the source of the incidence *Salmonella* among vegetables sold on market could be associated with the contamination from the farm practice. It can be summarized that meats and leafy green vegetables are likely significant sources of foodborne pathogens in Cambodia.

**Mating disruption for sustainable control of the invasive fall armyworm in smallholder farming in East Africa: Possibilities and Constraints**

Theme 1: Securing food and nutrition within planetary boundaries

**Thomas O'Malley**[1]
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**Abstract/Session concept note text:** Despite the potential of pheromone-based mating disruption to provide a sustainable solution for controlling fall armyworm in Africa, little research has been conducted on the role pheromones could play in pest control strategies for smallholders. This presentation will present the findings of a recent study that analysed the efficacy and suitability of pheromones to control this invasive pest in Tanzania. The trial found that when applied at an area-wide scale, pheromones were more effective than conventional insecticides at reducing fall armyworm populations and crop damage while also uncovering a number of opportunities and challenges for the uptake of pheromone use in lower-income countries.

Various political, economic, and social factors make the use of pheromones in Tanzania different to that of similar pest control methods that are already used on industrialised farms. Differences in plot sizes, coordination between farmers, economic incentives, a lack of political, regulatory, educational, or social support in decision making and pest control strategies are among the many factors that may affect the uptake of pheromone use in lower-income countries. To better understand these differences, perceptions of pheromone use by smallholders and their priorities for pest control were also studied, to identify obstacles and opportunities this method presents in the smallholder context.

Fall armyworm has already caused severe damage to maize harvests in Tanzania and presents a challenge for global security. Semiochemicals offer a sustainable solution for the management of fall armyworm, but must be used in a way that maximises their effectiveness and are suitable for smallholders.

Keywords: fall armyworm, pheromone-based mating disruption, smallholder, Tanzania, pest managment

**Climate change and ecological intensification of agriculture in sub-Saharan Africa – a systems approach to predict maize yield in push-pull technology**

Theme 1: Securing food and nutrition within planetary boundaries

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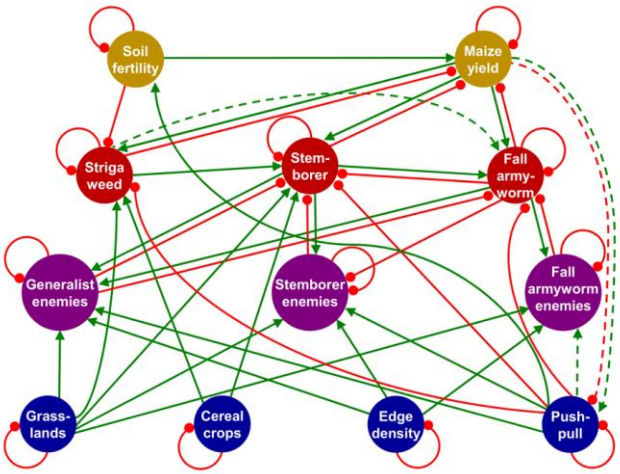
**Abstract/Session concept note text:** 'Push-pull' technology (PPT) is a poly-cropping design developed in eastern Africa that utilizes plant chemicals to mediate plant–insect interactions. PPT application increases crop productivity, by bolstering soil fertility and reducing pest damage caused by arthropods and parasitic weeds. As climate change effects are species- and/or context-specific, there is need to elucidate how, in interaction with biotic factors, projected climate conditions are likely to influence future functioning of PPT. Here, we first review how changes in temperature, precipitation and atmospheric $CO_2$ concentration can directly influence PPT components (land use, soils, crops, weeds, diseases, pests and their natural enemies) across sub-Saharan Africa (SSA). We then impose anticipated responses on a landscape-scale qualitative mathematical model of maize production in eastern Africa, to predict cumulative, system-mediated impacts of climate change on maize yield. The review suggests variable direct impacts of climate change on PPT components in SSA by the end of the 21st century, including reduced soil fertility, increased weed and arthropod pest pressure and increased prevalence of crop diseases, but also increased biological control by pests' natural enemies. The model predicts predominantly negative cumulative impacts of climate change on maize yield in eastern Africa. Nevertheless, maize yields can be sustained or increased by higher PPT adoption, preservation of field edge density and agricultural diversification beyond cereal crops. Our predictions can help guide management, policy-making and future research around PPT. Ultimately, we aim to provide the knowledge and methodological basis for reliable predictions of climate change impacts on ecological intensification across SSA and beyond.



## Panel 22 - Market access and supply chains

**Sustainability from the bottom up: Finding common ground for sustainable agriculture and food systems through multi-actor visioning in Mexico**

Theme 2: Governance and rights in food systems: Leaving no one behind

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**Abstract/Session concept note text:** Defining and assessing what we mean by "sustainability" poses a continued challenge to research, practice, and policy. While top-down sustainability frameworks abound (e.g., safe and just operating space, UN Sustainable Development Goals), rarely do we base sustainability assessments on local perspectives, which vary by context and the actors included in deliberation processes. In Mexican food systems, farmers face mounting pressures from global market liberalization and climate change, while consumers grapple with the double burden of malnutrition. Within a multi-year project that aims to highlight local sustainability solutions to these pressing challenges, our study first sought a pluralistic Mexican definition of sustainability, asking: How can recognizing shared values help to unify diverse agri-food system actors around a common vision of a sustainable future? Our study applied a mixed-methods design, collecting data through actor mapping, an online survey, and multi-actor visioning workshops. Participants were agri-food actors representing organizations that work toward sustainable agriculture and food systems in Mexico. To cover a diversity of perspectives, we invited both influential and marginalized actors from distinct food system and sustainability domains to participate. Survey data generated insights into diverse and divergent sustainability visions and underlying values across actors. Workshops yielded a list of shared values representing an integrated definition of sustainable agri-food systems in Mexico, as well as a shared vision which encompassed these values. Complementing top-down sustainability frameworks, our study used co-production methods to define a common values-based framework for future assessments of agri-food sustainability, including perspectives from across the Mexican agri-food system.

**Understanding the biofortified cassava market in Nigeria. Determinants of consumer demand and farmer supply**

Theme 1: Securing food and nutrition within planetary boundaries

**Ogbonnaya Ukeh Oteh**[1]
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**Abstract/Session concept note text:** Biofortified foods are smart nutritious foods which plays critical role in addressing global burden of micronutrients in many emerging economies. Biofortified cassava foods are strategic cost-effective and food security interventions, however, while there is more and more consensus about the potential benefits of biofortification, the challenge lies on how to scale up biofortified crops for consumption and its market system. This requires a better understanding of the dynamics of the biofortified cassava consumer demand and producers supply. This study aims to examine the factors that influence the demand and supply of vitamin A biofortified cassava products in Nigeria. A survey was administered to 240 willing consumers and 90 producers of biofortified cassava. The results revealed that price, marketing orientation, institutional support; price of substitute and education had a significant influence on supply, while the price of substitute, expenses on nutritional products, awareness of benefits, income, recommendation from experts, and education had a significant impact on demand biofortified cassava. Our study lends support to the important role of communication to improve awareness and increase adoption, while it highlights the need for institutional and infrastructural support to encourage market orientation and investments in biofortified crops.

Our evidence further suggests that both consumers and producers must be provided with the right incentives to ensure sustainable market growth. Although the government has shown commitment through policies that encourage agricultural transformation, institutional support is highly needed to scale up marekt demand. This lends support for addressing the current institutional challenges limiting agricultural productivity.

**Smallholder Farmers' Willingness to Pay for Improved Access to Irrigation Water Supply in Egypt: A Contingent Valuation Approach**

Theme 1: Securing food and nutrition within planetary boundaries

**Tabeer Riaz**[1]
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**Abstract/Session concept note text:** Egypt's agriculture heavily relies on the River Nile's water, accounting for approximately 80% of the available quantity. However, the country faces several fundamental problems, like a rapidly growing population, changes in agricultural land, and severe water scarcity. This water scarcity is crucial as it leads to various adverse effects, such as food insecurity. To confront this challenge, recent irrigation projects require farmers to contribute financially to enhance the projects' financial sustainability, water use efficiency, and equity. This study examined smallholder farmers' willingness to pay (WTP) for improved access to irrigation water supply, a previously understudied aspect in Egypt. A 313 Egyptian smallholder farmers survey was conducted using a double-bounded dichotomous choice contingent valuation experiment in the Nile Delta region, Fayoum province. An interval regression model is used to estimate the WTP and the determinants. The results indicated that farmers are willing to pay a significant amount of around 1250 Egyptian pounds (417 SEK) per feddan (roughly 0.42 hectares) for improved irrigation water supply i.e. around 4% of their annual income. Factors such as attitude towards technology adoption and efficient irrigation practices, and agricultural income have a significant positive influence on WTP. On the contrary, access to credit has a significant negative impact on WTP. These results have a significant implications for policymakers and other stakeholders as they better understand the farmers' behavior, who play a significant role in water use and agricultural production in Egypt. Furthermore, these results offer realistic estimates for designing tariffs and policy interventions.

**Contract farming and smallholder inclusion: factors motivating smallholder vegetable farmers into contract farming in South Africa**

Theme 2: Governance and rights in food systems: Leaving no one behind

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**Abstract/Session concept note text:** Contract farming in Sub-saharan Africa has been evolving significantly as an effective coordinating mechanism as traditional agriculture shifts into global food systems utilising modernised Agricultural Value Chains. In South Africa however, problems of smallholder farmers' participation in modern agricultural value chains through contract farming have been limited in the empirical literature. Based on secondary data from 732 farmers collected by Lima Rural Development Foundation, this study analyses the factors motivating contract farming adoption among smallholder farmers in South Africa.

To cater to the problem of selectivity bias, a Heckman two-stage model was then adopted to examine the factors crucial to smallholder farmers' contract farming adoption and the effect on contracting quantity. In the first stage of the Heckman two-stage model, the discrete choice contract farming adoption decision is assumed to follow a probit model. Thereafter, the quantity contracted is modeled conditional upon the adoption decision. The preliminary results of the Heckman two-stage model identified key factors including farmers' age, farming experience, sales income, and price to have significant effects on smallholder farmers' participation decisions, and price and transport cost to affect quantities contracted through contract farming. Based on these findings, effective policy interventions including these key factors could fashion and sustain an enabling environment that encourages greater smallholder inclusion.

**Keywords: smallholder farmers, inclusion, contract farming, market participation, Agricultural value chains**