Food systems for new realities
Agri4D 2021 Conference

28-30 September 2021

Book of abstracts

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Topic 1: Justice in Food Governance

‘The world has changed; these days, women are the ones who are keeping their families’. Gender norms, women’s economic empowerment and male capture in the rural Tanzanian poultry value-chain

Oral

Mr. Viktor Johansson [1]

1. *International Livestock Research Institute, CGIAR*

Viktor Johansson
International Livestock Research Institute, Dar Es Salaam - Tanzania

Keywords: Sustainable Development, Gender Studies, Women’s Empowerment, Gender Norms, Poultry
Abstract

This study explores how gender norms in four rural districts in Tanzania might influence women chicken farmers’ economic empowerment when an urban vendor introduces an improved breed of chicken. More specifically: the normative expectations for husbands and wives and how these may influence intra-household negotiation processes following a market-led intervention within the Tanzanian poultry value-chain; if and how intra-household resource allocation may be changed if profits were to increase within a women-led chicken business. Data was collected through scenario responses in eight Focus Group Discussions in Kilimanjaro and Lindi Region. Three findings are presented. First, women and men in the researched communities witness a changing society in which women increase their presence in the economy. In contrast, men struggle to live up to the expectations of breadwinnerhood. Second, women’s economic agency may both improve but also compromise women’s ability to adopt a practice of innovation if the practice is introduced without acknowledging gender dynamics. Finally, findings imply that development opportunities in the Tanzanian poultry sector add levels of negotiations where women and men need to negotiate gender norms in their communities while deciding on resource allocation in a growing business. In addition, *Male Capture*is brought forward as a central term.It is used to frame a dynamic in which *men seize control over a previously women-controlled asset once women have demonstrated the success of an innovation.*

A Micro-Level Exploration of Effect of Urban Sprawl on Malnutrition in Urban and Peri-Urban Households of Hyderabad, Telangana, India: A gender and diversity perspective

Oral

Dr. Padmaja Ravula [1], ***Dr. Nedumaran Swamikannu*** [2], ***Mrs. Kavitha Kasala*** [1], ***Ms. Jyosthnaa Padmanabhan*** [1]

1. *International Crops Research Institute for the Semi-Arid Tropics,* ***2.*** *International Crop Research Institute for the Semi-Arid Tropics*

India is rapidly moving through a nutrition transition with increasing prevalence of obesogenic environment in urban areas, where a complex interplay of individual, socio-economic and environmental factors influence the nutritional outcomes. From a sample of 662 households in urban and peri-urban areas of the Hyderabad region of Telangana, India, this study analyses the determinants of malnutrition among adults and adolescents using multivariate analysis. The results revealed that region of residence (urban; peri-urban), level of literacy, gender, social group, media exposure are the major factors influencing the nutritional status of the individuals. Residing in an urban area has the most substantial negative effect on the nutritional status, as it increases the likelihood of household members being in the obese and overweight groups relative to peri-urban areas. In case of adults, women have an increasing tendency to be overweight and obese significantly, while adolescent girls show a growing trend towards undernourishment, and adolescent boys tend to be in the overweight group. The study concludes with some recommendations, focused on both urban and peri-urban areas to understand the feedback effects of urban sprawl and associated drivers of nutritional outcomes. Ultimately, formulation of evidence-based food governance policies to the emerging new realities as urbanization unfolds further is an important outcome of this study.

A Shift From a Global Economy to Global Society: Through Equitable and Ethically Based Food System*

Oral

Mr. Prince Simunkombwe [1]

1. *Knowledge Exchange Hub*

Our study will Draw on comparative experiences of Sub-Saharan Africa and Asia where traditionally certain group of people are not allowed to own land due to cultural beliefs and tendency disposal; this paper argues on the need to shift from global economy to global society in which unequal food system that marginalises people based on gender (removal of female widow from customary land in Africa), caste (ethics of vegetarianism in India), and age does not exist. This neglected global society aims at promoting ethical concerns such as fairness and justice in food production by incorporating a number
of factors, which include maintenance of state sovereignty, individual freedom, and personal autonomy to own land as an asset for human survival. In this society, we propose a participatory mode ethics-based trading system, identifying land as a right of every human being. Methods of food production in a global economy puts a high risk on the environment and living standards due to market penetrations and international trade. Hence, in global society we shall call for trade-off between food security and environment protection to achieve an ethically-based food system passed on to future generations. Ethically based food systems should be able to detect interests of powerful people imposing their rule in the marketplaces, trade-off between eliminating hunger, poor diet, unsafe water, and large-scale industrialization that poses health threats if not properly monitored. An equitable and ethically based food system should incorporate three goals: improved well-being, improved public health, and protection of the environment.

AFRICAN INDIGENOUS LEAFY VEGETABLES (AILVs) PRODUCTION, LIVELIHOOD AND SUSTAINABLE DEVELOPMENT IN NORTH CAMEROON

Oral

Mr. Michael Vunyingah [1], ***Dr. Kotsiwe Motheo*** [2], ***Dr. Emmanuel Bumunang Wikochombom*** [3], ***Mr. Christiant Kouebou*** [4]

1. *Institute of Agricultural Research for Development, Cameroon,* ***2.*** *Indigenous Knowledge Systems Centre, Northwest University,* ***3.*** *University of Calgary, Faculty of Veterinary Medicine: Ecosystem and Public Health,* ***4.*** *Ministry of Agriculture and Rural Development*

African indigenous leafy vegetables play a pivotal role in the livelihood of households in Benue Division, north region of Cameroon. This is evident in quantities and quality of African indigenous leafy vegetables sold in urban (Central and Yelwa) and peri-urban (Takasco and Ouro Labo) markets of Garoua. The theoretical point of departure or main hypothesis is that the decline of African indigenous leafy vegetables, livelihood and sustainable development is link to the total marginalization and neglect of world rich indigenous knowledge systems. The study identified 13 African indigenous leafy vegetables, sold by 261 vendors, all women, exception of mbororo women. The decline of African indigenous leafy vegetables and livelihood is linked to structural and institutional factors: poor conservation methods, poor infrastructure, poor quality of seeds, low literacy, limited access to micro-financial institutions especially by indigenous women limited access to governance and decisions making, poor waste disposal system, land tenure insecurity, limited extension services, segregation of market infrastructures and sites. The phenomenon of hyper marginalization to communal resources is endured by Mbororo and Fali women. The cooperative framework model developed in the study constituting six core values (teamwork, competence, innovativeness, transparency, integrity, accountability) is critical for livelihood and sustainable development. Stakeholders should provide, for every phase of their municipal development planning, a statement of cultural dimension within the development plans including the ways and means of implementing such cultural dimensions. This approach to development planning will give all developments efforts a human face.

Keywords:Vegetables, Livelihood, Culture, Sustainable development, Cameroon

Agricultural land acquisitions unlikely to address the food security needs of African countries

Oral

Dr. Altaaf Mechiche-Alami [1], ***Ms. Jihad Yagoubi*** [2], ***Dr. Kimberly Nicholas*** [3]

1. *Department of Physical Geography and Ecosystem Science, Lund University,* ***2.*** *Otto Suhr Institute of Political Science, Free University of Berlin,* ***3.*** *Center for Sustainability Studies, Lund University*

In recent years, Large Scale Land Acquisitions (LSLA), direct land tenure changes have been gaining momentum in developing countries. In this study, we evaluate the potential extent to which agricultural land deals in Africa are able to address the host countries' food security needs, a commonly cited motivation for their establishment. First, we develop a framework to evaluate the priority food security needs of 38 African countries based on indicators of food availability, accessibility, stability, and utilization. Second, we estimate whether the crops from land deals would be sold on export or local food markets based on the origin of investments, type of investors and the intended crops. Third, we account for the characteristics of the locations where the deals happen in order to estimate the level of conflict and deforestation that they could exacerbate. We find that food security is mostly constrained by accessibility rather than production itself. LSLA are only likely to address the identified food security needs of 7 countries, while being at risk of increasing land pressures and conflicts or deforestation on 83% of the acquired area. We also find that the more productive lands are most often allocated to flex crops, while food crops are produced on more marginal lands. We thus argue that even when their purpose is agricultural production, most LSLA are not likely to improve food security; and recommend agricultural investments to be elaborated in consultation with local communities and marginalized groups to sustainably support their socio-ecological systems.

Applying the 'Ladder of Inclusive Innovation' to Examine Social Inclusion within Agricultural Training and Advisory Programmes in Kenya

Oral

Mr. Felix Opola [1], ***Prof. Cees Leeuwis*** [1], ***Prof. Laurens Klerkx*** [1], ***Dr. Catherine Kilelu*** [2]

1. *Knowledge, Technology and Innovation Group, Wageningen University,* ***2.*** *African Centre for Technology Studies*

With income inequality and access to resources remaining a concern in many regions of the world, there has been considerable interest among scholars and practitioners on how agricultural development programmes can include farmers with little resource endowments in their control, procedures and benefits. However, a holistic framework for assessing social inclusion within such programmes remains unknown. In this paper, we apply the 'ladder of inclusive innovation' concept from innovation studies to examine different levels and indicators of social inclusion within three cases of agricultural extension and advisory programmes in Kenya that aim to be socially inclusive. Findings indicate that there is a strong focus on intention and outreach of agricultural extension programmes to the farmers targeted compared to higher levels of inclusion such as including farmers in the procedures and management of the programmes and through change in existing policies and social structures. Additionally, strategies for social inclusion involve a trade-off between reaching a high number of farmers on the one hand and ensuring the programmes and services are adopted and useful to the farmers on the other hand. The theoretical implication of our study is that the ladder of inclusive innovation is not linear since different levels of inclusion can be achieved simultaneously. Our recommendation to practitioners is that different strategies to social inclusion such as basic inclusion, selective inclusion and mass inclusion can be employed depending on the desired outcomes and the needs of the targeted groups of people.

Cultivating emancipation in the city? A feminist political ecology of urban agriculture in Kigali, Rwanda

Oral

Ms. Karolin Andersson [1]

1. *Department of Urban and Rural Development, Swedish University of Agricultural Sciences, Uppsala, Sweden*

Farming and rearing livestock is a widespread practice in Kigali city, Rwanda. With high rates of urbanization amid Rwanda's state facilitated structural and agrarian transitions, urban agriculture may serve important purposes beyond food, income and employment provision to also bear significance for the reinforcement or resistance of neoliberal development trajectories. This study departs from the notion developed by feminist political ecology that struggles for access to and control over natural resources take place in everyday multilevel symbolic and material practices that are constitutive of subjectivities. Such practices are imbued with power relations along axes of differentiation such as gender, class, ethnicity and age. In this study, I draw on empirical material gathered from Mobile Instant Message Interviews via WhatsApp, including text, audio, video and photo material, with young urban farmers in Kigali. I analyze the reproduction and renegotiation of their gender subjectivities, as representations of what urban farming subjects may or may not be able to be, think and do. I aim to understand how such subjectivities are reinforced or contested to shape possibilities of change in terms of renegotiated power relations. While structural constraints and marginalization also pertain to power relations at larger scales, this study seeks to explore the emancipatory potential of urban agriculture through subjectivities, and its possibilities for young urban farmers towards more even and just environmental and natural resource processes.

Embedding equity in resilience thinking to support just food systems

Oral

Dr. Jennifer Hodbod [1]

1. *Michigan State University*

Resilience thinking is increasingly popular in the governance of food systems to support their capacity to respond to change as they continue to develop. However, in contrast to other social-ecological systems, power and equity are critical elements to understand within food systems but while increasingly discussed, these concepts are poorly operationalized within resilience thinking. The result is a limited understanding of the relationship between power, equity, and resilience in food systems, which limits theory building and application within resilience practice. In this presentation, I outline how ideas of power and equity have been conceptualized in resilience and a summary of the limited examples of their operationalization in food systems, mostly in the Global South. For example, 'resilience of what, to what, for whom' provides a frame to begin integrating ideas of equity, but case studies often focus on one group not the differentiated impacts across groups – this creates risks for inaccurate resilience assessments as the experience of the most marginalized may be missed. I then draw on examples from my own work across a spectrum of rural-urban food system contexts to suggest methods to operationalize power and equity within resilience assessments in food systems. To achieve just food systems, we need to ask critical questions about *whose* resilience is being understood and *how*. A broader approach to 'resilience for whom' is critical to understand the different experiences and outcomes for individuals and groups within a system, particularly the most food insecure.

Popular Food Governance: (Mis)using Concepts of Food Justice, Food Sovereignty and Agroecology

Oral

Dr. Anne Siebert [1]

1. *Institute of Development Research and Development Policy, Ruhr-University Bochum, Germany*

Recently, interrelated concepts of food justice, food sovereignty and agroecology have become ever more popular in the work of agricultural and environmental organizations including many non-governmental organizations and campaigns, as well as the United Nations. Beyond the widely recognized celebration of such innovative developments, critical reflection is urgently needed. These concepts and discourses are originating in and shaped by social movement responses and their allies, which call for consideration of vulnerable people's needs including their rights to food, land and water to name just a few aspects. However, practical experience on the ground, and the recent attempts to boycott the United Nation's Food Systems Summit reveal that organizations' application of these concepts are often too narrow, lack epistemic justice and restrict social inclusion. This contribution is guided by the overall question: How can agricultural and environmental organizations become more socially inclusive and truly engage with demands 'from below'? Against this background, this work has three aims: (1) to illuminate the powerful concepts of food justice, food sovereignty, and agroecology, (2) to sketch out difficulties in their application by high-profile organizations, and (3) to outline possible ways to overcome misinterpretation and related conflict. This work uses the case of the United Nation's Food Systems Summit 2021 and examples of food movement's and food governance in South Africa. Finally, this contribution concludes by calling for more sensitivity in agenda-setting and food governance as well as cooperation at eye level.

Sustainable livestock development in Hanoi city of Vietnam – the policies and challenges

Oral

Mr. Long Pham [1]

1. *International Livestock Research Institute (ILRI)*

The rapid urbanization of Hanoi requires means to safeguard the sustainability of the urban agriculture, in which livestock production plays an important role in terms of food security and livelihood of the citizens. A study combining interviewing key informants from provincial agencies and collecting documented data from them was applied to analyze the policies for livestock production, the animal population changes between 2014 and 2018, and major challenges for livestock development of the city. While a remarkable increase of the livestock population in recent years is evident, the dominance of small-scale farms, animal diseases occurrence, the slow progress of transiting farms out of urban areas, as well as the lack of analysis of climate change and gender impacts are major challenges that could affect the sustainability of the livestock development of Hanoi. This review about the present situation of urban livestock keeping in Hanoi and the relevant policies may be helpful for other growing cities in need of analyses of their own situation and their policies. In addition, this paper presents data on the importance of urban livestock keeping and the implications of policies on its development, which may be critical for planning of interventions for livestock health and productivity, as well as for food and feed security and safety, and public health aspects.

The Governance of the Standards of Thai Organic Rice: Opportunities and Challenges

Oral

Dr. Pailin Kittisereechai [1]

1. *Faculty of Social Sciences, Kasetsart University*

This research has two objectives. The first objective is to study the governance of the organic rice standards in Thailand in relation to the global governance of the organic agriculture standards and the second one is to understand problems of the governance process of Thai organic agriculture and try to propose solutions to those problems. Conducted qualitatively, this research gathered the information through documentary research and key informant interviews. The findings revealed that organic agriculture was initiated by non-state actors who were aware of the negative impacts of modern agriculture. Later, these actors internationally collaborated with one another and established a non-governmental international organization called the International Federation of Organic Agriculture Movement (IFOAM). Since then, IFOAM has played a vital role in the process of global governance of organic agriculture standards. Albeit with the absence of political authority and economic power wielded by states and transnational corporations respectively, IFOAM is regarded as an epistemic community of organic agriculture that holds 'epistemic authority'. Such authority operates through the global governance process in three dimensions which are dimension of regulation, dimension of knowledge contestation, and dimension of empowerment. In the case of Thailand, the process of the organic agriculture standards reflects conflicts between formal and informal institutions. The lack of cooperation between the government and non-governmental sectors has been a crucial obstacle to the development of the efficient governance process of the organic agriculture standards in Thailand.

The pandemic and women agribusiness in Vietnam and Myanmar from a feminist perspective

Oral

Dr. Nozomi Kawarazuka [1], ***Dr. Esther Achandi*** [2], ***Ms. Arunima Hakhu*** [3], ***Dr. Deepa Joshi*** [3], ***Dr. Cynthia McDougall*** [4], ***Ms. Loan Pham*** [2], ***Dr. Surendran Rajaratnam*** [5]

1. *International Potato Center, CGIAR,* ***2.*** *International Livestock Research Institute, CGIAR,* ***3.*** *IWMI, CGIAR,* ***4.*** *WorldFish,* ***5.*** *WorldFish, CGIAR*

COVID-19 has resulted in a colossal loss of livelihoods, incomes, and employment around the world. Women engaged in informal and low-paid food sector, many of whom are from marginalized socio-economic groups, have been reported to be hit the hardest. Drawing on female agri-entrepreneurs' lived experiences and their insights into the effects of COVID-19, this study explores structural barriers that are constraining disadvantaged groups of women entrepreneurs, and strategies that are enabling some women to adapt or even expand their economic endeavours under the local COVID-19 conditions. In-depth interviews are carried out with 32 female entrepreneurs in varying situations: women in towns in Vietnam on the border with China who engage in livestock trading; women in the Central Highlands of Vietnam who export horticultural products; and local informal fish traders in the southern coastal region of Myanmar. We employ feminist literature on entrepreneurship which critiques and challenges conventional male-oriented approaches to exploring entrepreneurship including indicators of measuring entrepreneurs' performance. Our study highlights the non-material dimensions of agri-businesses such as kinship networks, gendered values, cultures, norms, and ethics which define well-being and agency in agri-enterprises. These perspectives will be key to rethinking the structures and culture-inclusiveness of agri-food systems and post-COVID-19 governance. It concludes with demonstrating the value of using feminist methodologies in working towards equitable and inclusive food systems governance.

Towards the advancement of equitable food systems-A study focusing on Women With Albinism (WWA)

Oral

Ms. Charity Mashegede [1]

1. *Knowledge Exchange Hub*

Despite the significant roles that women are ascribed in food systems and in ensuring food security and nutrition, they face widespread and systematic institutional discrimination in access to assets such as land and services such as education, employment opportunities, credit, climate information and inputs. In sub-Saharan Africa, Women With Albinism (WWA) have historically experienced social discrimination and they face reinforcing deprivations, making them likely among the furthest behind. Considered as people with disabilities, the impediments they face are also manifested in their inability to engage fully with food systems. Unlike women with pigmentation, farming exposes them to heat, making them susceptible to visual impairment, skin damage and skin cancer. Worse still, institutions remain weak, and the lack of human rights monitoring perpetuates their already weakened sociocultural position and undermines their ability to achieve equitable livelihoods.
Women's rights are universal and indivisible and therefore, power dynamics and unjust structures that reinforce inequality should be transformed by integrating gender transformative approaches. With regard to food systems, government agencies and environmental organisations can adopt indoor oyster mushroom farming to diversify income for WWA and to reduce their vulnerability to adverse weather conditions. Oyster mushrooms are rich in protein and hence they can contribute to improved nutrition. Oyster mushroom farming can become a crucial part of a sustainable agriculture system for WWA since it is a low waste model that utilises organic waste and requires a moderate initial investment.

Keywords
Food governance, Women With Albinism (WWA), Social inclusion, Oyster mushroom, Gender Transformative Approaches

Unpacking Gender Relations and Power Dynamics in Watershed Development: Insights from Drought-Affected Bundelkhand, India

Oral

Dr. Ananya Chakraborty [1], ***Dr. Padmaja Ravula*** [1], ***Mrs. Kavitha Kasala*** [1]

1. *International Crops Research Institute for the Semi-Arid Tropics*

Integrated watershed development programs are crucial in addressing challenges like water scarcity, environmental degradation, groundwater availability, better crop and livestock productivity, and sustainable crop intensification across rainfed ecosystems in India. However, several studies have shown that local societies are heterogenous and exhibit unequal power relations along the lines of class, caste, and gender which inhibit equitable access and distribution of benefits in watershed programs such as water for drinking and agriculture, grazing lands, and forest-based resources. Using mixed-methods research from five drought affected villages in Bundelkhand region around the Parasai-Sindh watershed program in Jhansi district of Uttar Pradesh, we examine evidence of how gender relations and power dynamics shape the access and utilization of watershed benefits for local communities. Data from household survey and participatory qualitative research indicates that power inequalities at the local level are perpetuated along dimensions such as class, landownership, caste positioning, differences in education attainments, political participation, and patriarchal norms and social boundaries which are imposed differently on men and women. Such inequalities can be unintentionally reproduced through unequal partnerships between the local community and technologically focused watershed institutions. The hierarchies of power relations within local communities and between development institutions and the community affects the ability of the marginalized social groups, including women, to equitably benefit from watershed programs. Achieving sustainable development outcomes through natural resource management and agriculture development initiatives therefore need to be attuned to the diverse requirements of gender justice and mediate local and institutional power dynamics.

“There is no shame in poverty as long as one strives to elude it with proper education and honest work” Lysias, ancient Athenian lawyer

Oral

Mr. Alexandros Chouvardas [1], ***Mr. Dimitris Niapos*** [2]

1. *Swedish University of Agricultural Sciences,* ***2.*** *none*

An unfortunate commonality in almost all modern societies is the harsh reality that homeless people face. Their current status places them under the marginalized segments of our societies and the same status also keeps them in a vicious cycle of poverty and undernourishment. We, as future practitioners advocate for better access and participation of marginalized people in the food systems. Our idea is, to create a Non-Government Organization that will help to fulfill their needs by addressing the factors that force them in the margin. The proposed solution is to reinforce them on a psychological and personal level and provide them with the necessary tools to become productive members of the social and food systems. Our purpose will be to assist them to obtain knowledge and know-how on the practice of environmentally sustainable organic farming with educational courses and workshops, thus accessing food rich in nutritional value. Considering that, even when the calories are there, the proper amount of nutrition is not. After the skill-building and in cooperation with the local government we believe that they can be relocated into different locations of the rural areas, given that they get the proper means of production. This stage also benefits the current status of the rural, as in many European countries there is an issue with unfavorable land abandonment. This benefits the state, the local societies, and the marginalized people, by reclaiming access to natural resources and creating sustainable equitable rural livelihoods.

keywords: undernourishment, marginalized, rural areas, food systems, natural resources.

Assessment of Technical Competencies of Agriculture Extension Workers about Food Security in Southern Punjab, Pakistan

Poster

Dr. Muhammad Ali [1], ***Mr. Abdul Majid*** [1]

1. *PMAS-Arid Agriculture University Rawalpindi, Pakistan*

Agriculture and rural advisory services are becoming more challenging due to issues such as food and nutrition security. Agriculture Extension workers need to be technically competent so that they can cater the needs of farmers. To this end, the present study was designed to empirically evaluate technical competencies of agriculture extension workers regarding food security in Southern District of Punjab province namely Muzaffargarh. The data were collected from 120 agriculture extension workers through simple random sampling technique. The list of respondents was obtained from the local Department of Agriculture (extension wing). The pre designed and tested questionnaire was used as the research instrument. The competencies assessed through Likert scale (ranging from 1 as strongly disagree to 5 as strongly agree) items. The data were analyzed through SPSS (version 21). The findings show that an overwhelming majority (96.7%) of the respondents agreed that they had the competency to guide the farmers about food stability with mean of 4.97. Moreover, the majority of the extension workers (92.5%) exhibited competency in encouraging farmers for public and private investment for food security. However, the respondents highlighted that there is a lack of incentives for acquiring competencies and more competency enhancing programs may be initiated by the government to tackle food and nutrition issues particularly for resource poor farmers. The study suggests replicating this study in other areas of the country to examine competency gaps.

Keywords: Competency, agriculture extension, food security, South Punjab, Pakistan

Justice in Food Governance

Poster

Mr. Munashe Ncube [1]

1. *(Hon)Demography and Population Studies*

Despite the notable progressive initiatives to alleviate poverty there remains an unacceptable margin of food insecurity and nutritional deficiency that has emerged to intensify in the Sub-Saharan African region. The majority of poverty-stricken countries are heavily dependent on the exploitation of natural resources. As such the eradication of poverty needs to be addressed through collective efforts, which are attributed systematically to achieve strategic interventions. This global humanitarian challenge can be addressed by formulating an effective population consensus and population policy that is aimed at enforcing justice in the multifaceted dynamics of food governance. Considering the continuous global population increase, the livelihoods of the populace can be accomplished by encouraging food system stakeholder interactions to envision innovative, sustainable, and cost-effective large-scale food production. Poverty is not necessarily the lack of money, rather it is an outcome of the deprivation of access to the means of production. In Sub-Saharan Africa, the means of food production are largely owned by large institutions. The populace has limited access to preside over food governance affairs resulting in minimal benefit from the natural resources which they actively contribute in their extraction. The authorities in control of governing food systems have displayed mismanagement and corruption in the distribution of the resources. As such, there is a need to return meritocracy in food governance. Entrusting leadership principled on meritocracy in food governance institutions will achieve the saturation of individuals who look beyond gender, class, and other dimensions of socio-economic inequality.

Understanding the effect of urban sprawl on the smallholder farming systems: Qualitative insights from Telangana, India

Poster

Ms. Kanchan Ghugre [1], ***Dr. Nedumaran Swamikannu*** [1], ***Dr. Dilip Kajale*** [2]

1. *International Crop Research Institute for the Semi-Arid Tropics,* ***2.*** *Gokhale Institute of Politics and Economics*

Diversified farming systems have been the backbone of the small holder farmers. In order to address the challenges in crop and livestock production, irrigation and access to resources, mapping of the farming systems is a crucial step. Location specific context at farm level will help in ensuring equitable access to resources and thereby adoption of different approaches towards the resilience of the smallholder farming systems. For the present study, field explorations and qualitative elicitations using Focus Group Discussions were conducted with the farmers from six villages surrounding Hyderabad, the capital city of Telangana region, India. Interactions with local government officials and scientists were also carried out. The findings of the study show that agricultural communities are constrained by labour shortage, unavailability of irrigation water, conversion of land to development projects. These major challenges are due to disenchantment of the youth towards agriculture, migration for non-farm activities, attraction of urban lifestyle, uneven rainfall, high water demand from the city which has resulted in unviability of the existing farming systems in the community. It is observed that mitigation strategies to challenges posed by urban sprawl such as organic farming and investment in intensive dairy farming are at an early stage. Region specific urban demand driven farming systems are suggested which needs policy support.

Understanding the Role of Marketing Cooperatives in Agricultural Development: Case Study of Women Farmers and Entrepreneurs in Bamako

Poster

Ms. Asmao Diallo [1]

1. *Doshisha University*

When one raises the question of economic progress and development of developing nations, it is necessary to examine the role performed by small-scale female entrepreneurs and farmers, especially in countries where women play a crucial role in the informal agricultural value chain as food producers, processors, and traders. Literatures highlighted that women entrepreneurs and farmers across sub-Saharan Africa encounter significant barriers in accessing land, credit, equipment, and market. Lessening those challenges can help increase agricultural productivity and lead to economic development. In this context, cooperatives appear as a means through which women entrepreneurs and producers meet their socio-economic needs by maximizing benefits, reducing costs, and sharing risks. Mainly marketing cooperatives can enhance their members livelihood in both rural and urban areas while contributing to their better access to market, credit, trainings, information and extension agents in persistent gender unequal societies. Using data collected from 200 members of marketing cooperatives in urban and peri-urban Bamako, this article aims to understand the potential of marketing cooperatives in empowering women entrepreneurs and farmers in the agribusiness sector by providing evidence from women oral accounts. The outcomes reveal that women's involvement in cooperatives has some positive impacts on their access to productive resources, mainly market, credit, training, and information. The article ends with some policy recommendations on how to make women's involvement in marketing cooperatives more efficient in patriarchal settings.

Topic 2: Towards Improved Food and Nutrition Security from Smallholder-inclusive Food Systems

Adoption constraints and impacts of training sources and consumption behavior on supply of edible crickets in Kenya

Oral

Mr. Arnold Musungu [1], ***Dr. Beatrice Muriithi*** [1], ***Dr. Chrysantus Tanga*** [1]

1. *International Centre of Insect Physiology and Ecology*

In this study, we explore options that could help fast-track establishment of domestic cricket farming as an alternative rural households' food and nutrition security strategy. The increasing consideration of insects as an alternative sustainable food group follows emerging concerns with environmental sustainability of conventional animal protein sources. While prior literature documents acceptance of crickets as food and their potential applications in the food industry, there is insufficient evidence on what it would take to facilitate domestic adoption and ensure mass production and sustained market supply. Against this backdrop and consistent with the second theme of the Agri4D 2021, we first argue that given exposure to training, adoption of domestic cricket farming is not instantaneous but a two-step process. We show that providing rearing equipment, access to credit facilities and encouraging potential farmers to operate in groups or as partners would increase adoption rates. Secondly, we demonstrate that institutional training sources significantly increase cricket yields. Besides, we note positive knowledge spillovers evidenced by significant number of farmers who adopted cricket farming by learning from earlier trained cricket farmers. Lastly, we provide new evidence on the impact of household cricket consumption (cricket entomophagy) on market supply. Using an endogenous treatment effect model to recover the causal effect, we show that household cricket consumption (entomophagy) significantly increases market supply and has potential to increase market supply among non-consuming households. These results imply that embracing entomophagy would tremendously catalyze cricket farming and mass production. As such, training programs should focus on teaching entomophagy first.

Assessing the Legal Barriers to Eliminating Food Poverty in Local Plant Variety Protection Legislation – The Case of Zambia

Oral

Mrs. Chanda Tembo [1]

1. *School of Law, University of Zambia*

Despite advances made in new agricultural technologies, food poverty has been on the increase in many least developed countries of southern Africa, Zambia included. The food security situation in southern Africa has further threatened by the impact of climate change and the covid-19 global pandemic. Diminishing the possibility for a country such as Zambia in meeting the Sustainable Development Goals related to sustainably ending hunger at national level. Significantly, plant variety protection regimes have been viewed as the panacea for the elimination of hunger in developing countries. Consequently, nearly all countries in southern Africa that are members of the World Trade Organisation have enacted national plant variety protection laws to comply with Article 27(3)(b) of the Agreement on trade related Aspects of Intellectual Property Rights of 1994. Using the doctrinal approach this research examines the legal barriers to eliminating food poverty and to an inclusive plant variety protection regime that are entrenched in the Zambian Plant Breeder's Rights Act No. 17 of 2008. This research argues that in order to meet the sustainable development goals related to ending hunger in Zambia there is need for legislative reform to firstly, remove the legal barriers to eliminating food poverty in national plant variety protection laws; and secondly, redesigning national plant variety protection laws that are inclusive of small scale farmers and take into account the local context in order to develop and formulate inclusive, sustainable and appropriate linkages between plant variety protection laws and the local food systems in which they operate.

Assessment of Cassava Food Losses in the Cassava Value Chain in Enugu State, Nigeria

Oral

Dr. Jane Mbolle Chah [1], ***Mrs. Gloria Nkechi Ogbonna*** [1], ***Mr. Esdras Obossou*** [1]

1. *University of Nigeria, Nsukka*

Curtailing food losses in the cassava value chain is important to improve food security. The study assessed food losses of producers and processors in the cassava value chain in Enugu State, Nigeria.Multistage sampling procedure was used to select 240 respondents. Structured interviewed schedule and key informant interview were used to collect data for the study. Data were analyzed using descriptive and inferential statistics. The types of food losses identified were direct and indirect. Some of the food losses were used to feed animals, used as manure and processed to less value food for human consumption. The direct losses were attack by mold and pest on tubers and damage by rodents, while the indirect losses were damage by microorganisms and poor patronage for producers, damage due to bad road and wastage during peeling for processors. Major constraints to curtail food losses were inadequate income, poor road network, lack of appropriate equipment for harvesting and processing, inadequate market facilities and lack of storage facilities. Majority of the respondents were not visited by extension personnel. Strategies to reducing food losses were provision of proper harvesting and processing tools, careful digging of roots, provision of market information and use of good storage facilities. There was significant influence of socioeconomic characteristics of respondents on food losses. There was no significant difference of the losses incurred by producers and processors. Farmers should be trained by extension personnel on how to save already produced and processed cassava foods. The government should established food losses mitigation policy.

Exploring adaptive capacity dynamics in the Lower Omo, Ethiopia to ensure food security

Oral

Ms. Sarah Slinkman [1], ***Dr. Jennifer Hodbod*** [1]

1. *Michigan State University*

Smallholder food systems are increasingly connected to national and international food systems, through integration into markets, rural-urban migration, and land investments. An example of this is the construction of the Gibe III hydro-electric dam and associated cultivation of commodity crops in large-scale estates in Ethiopia's Lower Omo, traditionally an agropastoralist region with diverse politico-territorial groups dependent on flood-recession agriculture that are poorly integrated into the state. Agropastoralist communities in this region (and around the world) utilize diverse livelihood strategies to ensure resilience in social-ecological systems with regular environmental shocks. But mega-projects and new interactions with external actors (federal governance, private investors, migrant groups) have potentially led to the limits of that adaptive capacity and thus resilience. We use a longitudinal case study of the Nyangatom in the Lower Omo to firstly demonstrate the traditional forms of diversity that underpin adaptive capacity and thus food security in agropastoralist food systems. We build on this to describe how adaptive capacity has been utilized to respond to change created by the mega projects and where the limit to adaptive capacity lies, as our most recent data shows that 90% of Nyangatom households are in a food insecure state. Secondly, we explain these high levels of food insecurity by discussing the failures thus far in including smallholder households in such agricultural developments. We use the lessons from this failure and visioning with communities to outline potential solutions to support adaptive capacity and food security through their inclusion in the future.

Kurwa, a system of shifting cultivation towards food and nutrition sovereignty among the Paharia people of Sundar Pahari, Godda District, Jharkhand, India

Oral

Mr. Rohan Mukerjee [1], ***Mr. Soumik Banerjee*** [2]

1. *Keystone Foundation,* ***2.*** *Independent Consultant*

The Paharia people, one of Jharkhand's tribal groups, residing in the hills of Sundar Pahari Block meet food and nutritional needs through a food system based around the traditional shifting cultivation practice of *Kurwa.* A settlement between the Paharia and the British colonial government in the early 20th Century resulted in the forests of Sundar Pahari being privately owned with villagers possessing documents dating back to British rule. Paharia farmers have adapted their shifting cultivation practice to include one year of *Jara*involving cultivation of commercial legume crops like cowpea and rice bean without any burning. In the second year they practice *Kurwa*cultivating a variety of commercial and subsistence crops. Across all agricultural practices the Paharia cultivate over 34 crops which include legumes, millets, maize, oilseed, and vegetables. Cultivated food is supplemented with a variety of wild food that includes wild greens, fruits, seeds, flowers, tubers, mushrooms, barks and gums, aquatic species and insects comprising around 152 different species. However, there are several challenges to this food system which include increased commercialisation of shifting cultivation resulting in reduced crop diversity, loss of traditional seeds, reduced fallow periods, forest degradation, spread of invasive species; change in diets, increased dependence on the market and PDS for food. Initiatives to counter challenges and improve sustainability include establishment of community seeds banks and revival of cultivation and consumption of traditional crops and foods, forest gardens of shade tolerant species in forest fallows and guided fallows to improve sustainability and viability of *Kurwa.*

Sustainable practices towards overcoming barriers along village chicken production value chains for smallholder farmers: A case in Luanshya, Zambia

Oral

Mr. Humphrey Hamusonde Maambo [1], ***Mr. Joseph Simukoko*** [2]

1. *University of Zambia,* ***2.*** *TechnoServe Zambia*

Village chicken production presents one source of income for smallholder farmers in Luanshya, Zambia. To improve farmers' income, technology gaps along village chicken production value chains were identified. Technologies were benchmarked and adapted to suit smallholder farmer needs while involving private and public sector stakeholders in the village chicken value chain. Village chicken consumer preferences were determined and their willingness to pay was recorded. The effectiveness of introduced technology interventions in traditional village chicken rearing practices was evaluated. Farmers in Luanshya faced three (3) main village chicken production challenges: 1) Limited access to markets due to non-existent linkages between production and consumption, 2) Lack of access to information such as vaccination options for diseases such as Newcastle that kills 80-90 % of their bird flock annually, and 3) Lack of access to key inputs such as effective supplemental feed, and effective/affordable chicken housing structures. To overcome these challenges, farmers were trained to develop appropriate chicken housing structures using local materials and introduced to recommended flock management practices. Biosecurity around chicken rearing areas was enhanced to prevent the spread of disease by erecting fences, encouraging vaccination as well as natural prophylaxis, installing foot baths, and tippy-taps for hand washing. Farmers were also encouraged to use appropriate feeding regimens and linked to established marketing channels. Four hundred thirty-two (432) smallholder farmers (289 female; 143 male) benefitted from the technology knowledge transfer model and innovation. Approximately USD 76,000.00 has been generated so far from chicken sales demonstrating increased income and poverty alleviation.

The relations of maize- an interdisciplinary understanding of crop-led agriculture development in Africa

Oral

Dr. Klara Fischer [1]

1. *Swedish University of Agricultural Sciences*

New possibilities brought by advancements in biotechnology have accelerated efforts to improve food security in Africa through the introduction of new crops. However, smallholders, who produce the majority of the food in Africa, have adopted these new crops to a limited extent. Research has struggled to explain why. My starting point is that an important reason for this research gap is the lack of interdisciplinary engagement with the issue. While plant breeders concentrate on crop properties, social science research on technology adoption has traditionally focused on the farmers and their relations with other humans. However crop function is a result of the interaction between crop properties, humans and other non-human actors. Therefore an understanding of the role of crops in smallholder agricultural development needs to build on an understanding that crops, together with a wide set of social and ecological factors create development outcomes. Through the concept of relational agency, and with a focus on maize- the dominant staple crop in Africa, I explore how maize, as a result of intra-action between maize biology and choices made by various human actors, from the colonial era until today, have impacted the ability of maize to be a route out of poverty for smallholders. Based on examples from my research in South Africa I will also suggest in what forms and constellations I think that maize can be a component in successful smallholder agricultural development and improved food security in Africa.

Vermi-composting improved the livelihood of women-headed households through increased agricultural productivity in northern Ethiopia

Oral

Dr. Kassa Teka [1], ***Mr. Yemane Welday*** [1], ***Mr. Efrem Gidey*** [2]

1. *Mekelle University,* ***2.*** *Wukro St.Mary's Institute*

Abstract:
Agriculture in the developing world such as Ethiopia is characterized by high soil degradation, rain-fed and fragmented land holding, extremely low external inputs and high dependency on traditional farming techniques, which affects its productivity. Women headed households are most vulnerable to these challenges. Hence, the SIDA funded AgriFoSe2030 project has introduced vermi-composting as a new organic farming technology on selected women headed households in Tigray (northern Ethiopia) to diversify their sources of livelihood and boost their resilience to climate change and variability. Nevertheless, the level of impact of the technology was not well studied and its scale-up was limited as a result. Hence, both field experiment and household survey were the data collection methods applied taking agricultural productivity as an indicator. Experimental studies on maize and bread wheat showed that vermi-compost addition doubled crop yield as compared to conventional compost and chemical fertilizer. Hence, the produced vermi-compost generated an income of around 116 to 582 US Dollars per household. Furthermore, household heads perceived the technology as beneficial due to improvements in soil fertility and crop productivity, reduced cost of purchasing chemical fertilizer, easy technology that can be managed by any family member and improved household sanitation through continuous waste removal as worm feed.
Key words: vermi-compost, chemical fertilizer, conventional compost, livelihood, female-headed households

Topic 3: Agroecology

A Framework to assess adoption of agroforestry technologies Nexus: Food security and landscape restoration in semi-arid areas of Tanzania

Oral

Ms. Mahlet Degefu Awoke [1], ***Dr. Katharina Löhr*** [1], ***Dr. Marcos Lana*** [2], ***Dr. Anthony Kimaro*** [3], ***Mr. Johannes Hafner*** [1], ***Dr. Götz Uckert*** [1], ***Dr. Stefan Sieber*** [1]

1. *Leibniz Centre for Agric. Landscape Res. (ZALF), Sustainable Land Use in Developing Countries (Sus- LAND),* ***2.*** *Swedish University of Agricultural Sciences,* ***3.*** *World Agroforestry (ICRAF)*

Ongoing land degradation is a major challenge for food production in most developing countries, and agroforestry is considered a win-win solution to enable farmers to combat degradation. Tanzania's dryland consists of a wide range of arid, semi-arid, and dry sub-humid areas and covers about 61 % of the total landmass. Ranking low in economic and human development indicators, Tanzania is at risk of meeting food demand as the majority of the population depends on rainfed agriculture for livelihood. Even though agroforestry opportunities exist, there is still a wide range of constraints facing the adoption of agroforestry technologies in Tanzania. The proposed study aims to develop a methodological framework to facilitate the identification of underlying constraints for wider adoption of agroforestry technologies in the semi-arid areas of Tanzania. The assessment is based on the (ex-ante) evaluation of the adoption potential considering socio-economic and institutional factors. Two assessment frameworks (MESMIS and ScalA) are selected for the current study and will be adapted and contextualized to fit the study area's local condition. Assessment indicators will be identified based on sustainability attributes from ScalA and MESMIS methodological principles. New indicators for the specific context will be developed using a participatory approach by involving farmers, local experts, and researchers. The findings to be presented will provide a methodological framework that enables wider adoption of agroforestry technologies. The new framework will take Tanzania's context into account but will also be applicable to other similar and comparative settings.

Keywords: adoption, agroforestry, indicators, semi-arid areas, sustainability assessment

agroecology for new realities

Oral

Ms. Muneezay Jaffery [1]

1. *Green Shoots Foundation*

Green Shoots has been working in the realm of Agroecology for the last seven years. Whether working on school vegetable gardens or our own Agriculture training Centre, the intention has been to create a microcosm that is demonstrative- a space that provides and teaches. In 2018 we established our award-winning eco-built Agriculture Training Centre in North West Cambodia. It operates as a community centre, open to all and with its existence advocates for a better food system. We look to agroecology as our guiding light for building resilience in communities and ecological cycles. In the middle of 2020 we find ourselves at a crossroads as we try to ascertain a new reality. How does COVID 19 and the world to come look like for a small provincial town close to the Thai border? So far, we have seen an increase in food prices, a massive influx of migrant workers returning back from Thailand and urban areas. There are few job prospects for them during the early days of lock-down food availability in markets was disrupted due to heavy reliance on imports from Vietnam and Thailand. How does this new reality impact the community we operate it? We hope agroecology techniques for growing food such as integrated farming and nature-friendly farming pave the way for low-cost solutions and food-secure communities. By promoting “diversity on the farm and diversity on the plate” we regenerate disrupted ecological cycles, improve soil fertility and ensuring households can provide for families and have nutritionally diverse diets

Food for the future! Agriculture Scenarios for climate and environment

Oral

Dr. Artur Granstedt [1], ***Dr. Olof Thomsson*** [2]

1. *Swedish Biodynamic Research Institute,* ***2.*** *SBFI*

1. Dr. Artur Granstedt & Dr. Olof Thomsson - Swedish Biodynamic Research Institute

The food's climate impact in Sweden is calculated at 18.8 million tonnes CO_2 eq. (approximately 2 tonnes CO_2 eq. per capita and year - about 20 % total per capita climate foot print) including imported food and production resources from other countries. This includes the use of chemicals in agriculture, imported feed and emissions from deforestation to produce more agricultural land for meat consumption. The selected 22 good-example farms fulfil the definition for ecological recycling agriculture with integration of crop and animals according the EU part funded project BERAS. The results show that the low input example farms' climate impact per hectare of agricultural area on average was 82 to 88 % lower , taking into account the carbon sequestration in the soil in each cultivation system and the nitrogen surplus 43 % lower than today's average conventional agriculture in Sweden. Two scenarios, based on two different diets, showed that national self-sufficiency (for 11 million inhabitants by 2030) based on the example farms, using mainly local and renewable resources, could be produced on a total of 2.7 to 3.1 million ha (available today 3 million ha but historically 3.5). It requires however a radical dietary change with a 44 % reduction from today's average consumption of meat from ruminants and at least 90 % less meat from monogastric animals.
Key words: Recycling agriculture, food's climate impact, dietary change, food scenarios, self-sufficiency

Industry-led sustainability certification or agroecological change in cocoa production? Stakeholder perspectives on the future of cocoa in Ghana

Oral

Dr. Franziska Ollendorf [1], ***Dr. Katharina Löhr*** [1], ***Dr. Stefan Sieber*** [1]

1. *Leibniz Centre for Agric. Landscape Res. (ZALF), Sustainable Land Use in Developing Countries (Sus- LAND)*

Departing from the persistence of major sustainability challenges in cocoa production such as severe poverty among cocoa producers and associated high rates of child labour and deforestation, we provide an empirical-based discussion of how sustainability certification shapes the prospects of a broader paradigm shift in Ghana's cocoa production towards a more holistic approach to sustainability which we capture with the concept of agroecology. Sustainability certification in its current form has shown to fail to mitigate sustainability challenges and even counteracts with the goal of a healthy and sustainable future of cocoa production. Our results indicate that sustainability certification endangers social cohesion in cocoa producing communities by fragmenting them into beneficiaries and non-beneficiaries and creating new disparities. Also, by privileging external top-down interventions over existing local knowledge and innovation capacities, and by prioritizing intensification over diversification strategies, sustainability certification establishes new structures in the local cocoa sector which go opposite to agroecological approaches to agricultural change. Based on qualitative data we collected in the Ghanaian cocoa sector in 2021, our analysis offers an empirical insight in how different stakeholders perceive such hidden dynamics and how those shape their visions about alternative future pathways of cocoa production. The discussion aims to contribute to the understanding of institutional and governmental barriers to sustainable agricultural change and new, more equitable realities.

On-farm experiences shape farmers‘ knowledge and perceptions of pollinators and their decision-making

Oral

Mrs. Julia Osterman [1]

1. *Martin Luther University of Halle-Wittenberg, General Zoology, Institute for Biology, Hoher Weg 8, 06120 Halle (Saale), Germany*

Animal pollination underpins the viable production of two-thirds of the crops produced globally but declines reported for several pollinator groups might threaten their service delivery and resilience. Mitigation measures in agricultural-dominated landscapes require the involvement of farmers and their willingness to adopt pollinator-friendly strategies. However, growers‘ knowledge, perceptions, and actions are rarely evaluated. To close this knowledge gap, growers from 11 countries (N = 560) were interviewed, cultivating at least one of four widely grown pollinator-dependent crops with the focus on non-bees. We found that farmers perceive the importance of pollinator groups differently, with bees being considered more important pollinators than non-bees. However, around 75% believe that non-bees contribute to the pollination of their crop, seeing them as additional pollinators rather than substitutes for bees. Despite farmers rating their own observations as being the most important source of information, their knowledge aligned closely with available scientific studies across crops and countries. Farmers‘ perceptions, as well as governmental subsidies, were also linked with their managing practices. Farmers adapt practices to enhance pollination services depending on the crop, which indicates an understanding of differences in the pollination ecology of crops. Almost half of the farmers changed the on-farm pollination management in the past 10 years, indicating the lack of clear guidance from scientists on best practices. Our findings highlight the importance of studies investigating farmers‘ knowledge and perceptions, to further understand how on-farm biodiversity can be enhanced to provide sustainable and pollinator-integrated food production.

Recycled Pangasius pond sediments as organic fertilizer for vegetables cultivation: strategies for sustainable food production

Oral

Dr. Thi Da Chau [1]

1. *Faculty of Applied Sciences, Ton Duc Thang University, Ho Chi Minh City, Vietnam*

Intensive *Pangasius* aquaculture farming contributes to increased income and profits in Vietnam, but is also associated with many environmental problems, including pollution from nutrient rich water and sediments that are released into the environment. This article investigates the feasibility of using Pangasius pond sediments (PPS) in combination with amendments of rice straw (RS) to fertilize cucumber (*Cucumis sativus*L.) and water spinach (*Ipomoea aquatica* Forssk) plant. The results showed that a mixing ratio of 30% PPS with 70% RS produced the highest nutrient concentrations. The study demonstrates that organic fertilizer produced from PPS in combination with chemical fertilizer can replace 25 % to 75 % of the inorganic fertilizers used as a nutrient source for cucumber and water spinach, and also increase the vegetable production. The highest yields were found for treatment PPS_{-3} (a combination of 50% chemical fertilizer and 50% organic fertilizer used on cucumber), and for treatment PPS_{RS-4} (a combination of 25% chemical fertilizer and 75% organic fertilizer used on water spinach) in both the wet and dry season (P˂0.05). The lowest yields were found when growing cucumbers and water spinach either with 100% organic fertilizer (the treatment PPS_{-5}) or with 100% chemical fertilizer (the control treatment PPS_{-1}), respectively (P˂0.05). Overall, the results indicated that the recycling PPS as organic fertilizer and chemical fertilizer in combination for vegetable cultivation is more environmentally friendly as compared to using only chemical fertilizers

Unraveling the role of Farmers' Organizations in the promotion of agroecological techniques in Burkina Faso

Oral

Mr. Aboubakar Iyabano [1]

1. *Knowledge, Technology and Innovation Group, Wageningen University/Montpellier SupAgro*

Agro-ecology has been recognized as a potential solution to solve actual challenges of agriculture production by offering multiple economic, social, and environmental benefits of agricultural systems. The concept is variously defined by scientific and political actors as a science, a movement, and a practice. The aim of agroecology is to develop agroecosystems with minimum dependence on synthetic inputs thereby increasing farmers' control over their productive resources. This development is mostly facilitated through the actions of intermediaries' bodies such as Farmers' Organizations in the context of developing countries. Thus the aim of this study is to unravel the role of Farmers' Organizations in the promotion of agroecological techniques in Burkina Faso. A multiple case study approach was used to understand the reason and the process of the Farmers' Organizations' promotion of agroecological techniques. The results from the case studies reveal that the Farmers' Organizations' promotion of agroecological techniques is mostly related to one of these three goals: enhancing the productivity of commercial crops; improving the resilience of subsistence farmers; and enhancing both the productivity of commercial crops and the resilience of subsistence farmers. Farmers' Organizations fulfill these goals by providing the necessary economic and technical support services to their farmers. The study concludes by suggesting areas for further research related to the detailed description of farmers' adoption of agroecological techniques in a country like Burkina Faso.

Analysis of seed and ware potato production systems and yield constraints in Zimbabwe: towards sustainable production, food security and improved livelihoods.

Poster

Mr. Oniward Svubure [1], ***Mr. T Chapman*** [1]

1. *Chinhoyi University of Technology, Department of Agricultural Engineering, Horticulture Research Institute*

Although the government of Zimbabwe declared potato as a strategic food security crop in 2012, production has not increased to expected levels. Apart from the hard economic prevailing environment, inadequate and lack of improved quality seed remains a major problem. Most farmers use very old and low yielding varieties thus leading to market shortages. There is a need to take advantage of bio fortified varieties to improve nutrition of both urban and rural communities.This requires improved varieties and adoption of technologies that promote continuous supply of pathogen free seed. Use of apical cuttings from tissue cultured plantlets is a rapid multiplication technique that has been explored by other countries but not done in Zimbabwe. The conventional method currently employed is inefficient. It is time specific and slow. A rooted potato cutting is similar to a nursery grown seedling. The objective of the study is to determine the performance of selected Zn and Fe bio fortified potato varieties and to define best nursery management options for apical cutting production in Zimbabwe.

Keywords: Irish potato, apical cutting, nursery management, variety performance, Bio fortified varieties

Arbuscular mycorrhiza for Striga control in smallholder farming systems

Poster

Dr. John Baptist Tumuhairwe [1], ***Dr. Sigrun Dahlin*** [2]

1. *Makerere University,* ***2.*** *Swedish University of Agricultural Sciences*

Striga (witch weed), is a genus of parasitic weeds of cereals and is prevalent on low-fertility soils in arid and semi-arid areas. There is no single effective method for controlling *Striga* but fertilisation (especially with phosphorus) and intercropping with non-host legumes are known to decrease *Striga* infestation. Arbuscular mycorrhizal fungi (AMF) inoculation has been found to decrease *Striga* attack in pot trials. In this study, we determine a) the efficiency of inoculation with AMF in suppressing *S. hermonthica* germination and biomass, and b) the agronomic benefit of this inoculation on maize yield in farmers' fields infested by *S. hermonthica*, with and without *Phaseolus vulgaris* intercropping and/or phosphorus fertilisation. On-farm experiments are conducted in eastern Uganda 2020 and 2021. Preliminary results indicate that maize yields consistently increased following AMF inoculation across the inoculation and residual seasons 2020. However, the treatment neither suppressed the germination nor the biomass of the weed.

Keywords: arbuscular mycorrhiza, maize, *Phaseolus vulgaris*, phosphorus fertilisation, *Striga*

EFFECT OF EXOGENIC PROLINE AND ARGININE ON GERMINATION, VIGOUR INDEX, ROOTS LENGTH AND FRESH MASS IN POLISH SPRING WHEAT CULTIVARS UNDER SALT STRESS CONDITION

Poster

Mrs. Justyna Pelc [1], ***Mr. Rafał Kobak*** [1]

1. *West Pomeranian University of Technology*

The 21st century has been marked by shortage of fresh water resources, increasing environmental pollution and salinization of both soil and fresh water resources. Salinity is one of the most significant abiotic stress which lowers wheat yield. An efficient technique of reducing negative effect of salinity to wheat crop and improving germination, is seed priming by exogenic amino acids. This might be a good alternative for chemical seed priming. In our study effect of 12h seed priming in exogenic proline and arginine (0.5 mmol·dm^{-3}) on the growth of two polish cultivars of spring wheat (’Eskadra' and 'Merkawa') subjected to salt stress was investigated. During examination, seeds were soaked in 0,5 mmol·dm^{-3} proline and arginine solution for 12h. After that seeds were placed in Petri dishes for 72h with: control (distilled water) and 50 mmol·dm^{-3} NaCl solution. The obtained results have shown an increase in germination, vigor index, root length and fresh mass after both proline and arginine priming. Moreover significant alleviation of salt toxicity was also observed. Extended research are needed but our first studies proves some amino acids could be used in practice with success, especially in organic farming. It might be a environmentally friendly weapon against salinization of soils and which is a bigger issue from year to another. Influence of amino acid should be checked also for other economically significant species like corn, rye or commonly cultivated vegetables. We believe there is much potential in this approach and it is worth additional efforts which are obviously needed.

Embracing the whole farm approach as a way of promoting economic, environmental and socially sustainable food production

Poster

Mr. Perez K Katambala [1]

1. *Knowledge Exchange Hub*

The increasing global demand for agricultural products has led to deforestation at a rate of 4 million hectares per year in Africa contributing 90 percent of forest loss. This has distorted the rainfall distribution patterns, the ecosystem and has endangered diverse fauna and flora. The once forest areas, now farmlands, are nutrient-rich, which initially give high crop yields but plummet with time. This creates more demand for forest cover for agricultural use to maximize crop production for economic and home use. Approximately 50% of the food consumed globally comes from smallholder farms. Due to escalating food demands, there is a notable shift from subsistence to commercial monoculture. African small-scale farmers too are embracing this new trend and are using pesticides and inorganic fertilizers to maximize productivity. The traces of these farm waste products are noted in water sources affecting aquatic life and finally in the food chain predisposing humans to lifelong health conditions. We propose a disruption in the status quo. This requires a multi prong approach which includes; biodiversity, soil health, water conservation and ecological pest management. In this project we will promote conservation tillage and soil health where;

1. Land texture is minimally disturbed (previous crop residues are left behind to increase; organic matter, improve water penetration and retention from rainfalls, soil porosity and regeneration of microorganism population hence improving fertility).
2. Diversify crop rotation to include; cover crops, forages and heavy residue crops which further increase the organic matter.

Keywords; Deforestation, crop productivity

Growth and yield of amaranth crop (Amaranthus cruentus L.) as affected by Siam weed compost tea

Poster

Mr. Judicaël DANDJLESSA [1], ***Dr. Norliette ZOSSOU*** [1], ***Mr. Bénoît EZIN*** [1], ***Mr. Auriol DJENONTIN*** [1], ***Dr. Félix ALLADASSI KOUELO*** [2], ***Prof. Adam AHANCHEDE*** [1]

1. *Laboratory of Plant Biology, Faculty of Agronomic Sciences, University of Abomey-Calavi,* ***2.*** *Laboratory of Soil Microbiology and Microbial Ecology, Faculty of Agronomic Sciences, University of Abomey-Calavi*

Amaranth crop is the most popular leafy vegetable in Southern Benin and is therefore produced in almost all urban and peri urban agricultural systems. Nevertheless, its production encounters many constraints among which the decline in soil fertility is one of the major. This study aimed at accessing the effectiveness of *Chromolaena odorata* compost tea as liquid fertilizer in the improvement of amaranth production. This experiment was carried out in Sitatunga valley in congolo-guinean zone of southern Benin. The compost tea was browed using the aerobic method and the treatments were made of four doses of compost tea arranged in a Fisher block design with four replications. Growth data collected every week were analyzed using ANOVA with repeated measures, and yield was evaluated by the plant biomass at harvest and submitted to ANOVA. The results of analysis showed that the compost tea has significantly improved the growth of plants as far as the number of leaves and the height of plant are concerned ($P < 0.05$). The treatment has very highly increased biomass yield ($P < 0.001$) of amaranth going from 4.87 ± 0.09 t/ha for the control to 15.10 ± 0.11 t/ha for the highest dose. The compost tea of *C. odorata* has enhanced the production of amaranth and is thereby an agroecological alternative to agrochemicals. It is nevertheless compulsory to carry out further researches on dose recommendation of compost tea for integrated soil fertility management in vegetable crop production.

Impacts of Long-term Integrated Nutrient Management on Crop Yield and Soil Health in Northern Ghana

Poster

Dr. Edwin K. Akley [1], ***Dr. Nutifafa Adotey*** [2], ***Dr. Eric Obeng*** [3], ***Dr. Peter A. Y. Ampim*** [4], ***Dr. Eric Owusu Danquah*** [5], ***Dr. Theophilus K. Tengey*** [6], ***Dr. Ophelia Asirifi Amoako*** [1], ***Mr. Mawuli Yevu*** [1]

1. *CSIR-Savanna Agricultural Research Institute, P.O. Box TL 52, Tamale, Ghana.,* ***2.*** *University of Tennessee, Biosystems Engineering and Soil Science Labs Building 2500 E J Chapman Drive Knoxville, TN 37996-4500, USA,* ***3.*** *Department of Agriculture, Nutrition and Human Ecology and Cooperative Agricultural Research Center, College of Agriculture and Human Sciences, Prairie View A&M University, P.O. Box 519, MS 2008, Prairie View, TX 77446, USA,* ***4.*** *Department of Agriculture, Nutrition and Human Ecology and Cooperative Agricultural Research Center, College of Agriculture and Human Sciences, Prairie View A&M University, P.O. Box 519, MS 2008, Prairie View, TX 77446, USA.,* ***5.*** *CSIR-Crop Research Institute, P.O. Box TL 3785, Kumasi, Ghana,* ***6.*** *CSIR-Savanna Agricultural Research Institute, P.O. Box TL 52, Tamale, Ghana*

Integrated nutrient management (INM) holds the key to food security and soil health, but limited information exists on long-term INM effects on soil and crop productivity in Ghana. A study was conducted in Nyankpala to evaluate the impacts of integrated application of mineral fertilizer and compost on crop production and selected soil quality indicators after eight years. The experiment was designed as a split plot. The main plot was allocated to three NPK fertilizer levels; 0-0-0 (control), 30-30-30 and 60-60-60 kg NPK ha^{-1} while the subplot comprised four compost application rates: 0, 2, 4, and 6 t ha^{-1}. Assessment was made on maize and cowpea yields, bulk density, soil organic C, permanganate oxidizable C (POXC) and microbial biomass. Grain yield of maize and cowpea, POXC, and microbial biomass were significantly ($P<0.05$) affected by mineral fertilizer levels x compost rate interactions. The maximum grain yield was produced by 60-60-60 kg NPK ha^{-1}in combination with 2, 4, and 6 t ha^{-1} compost, respectively, while sole compost application yielded the least grain yield. Across all treatments, 0-0-0 kg NPK ha + 4 t ha^{-1} compost produced the outstanding cowpea grain yield. Increased POXC and microbial biomass were obtained with 60-60-60 kg N P K ha^{-1}+ 4 t ha^{-1}compost and 30-30-30 kg NPK ha + 4 t ha^{-1}compost, respectively, across all treatments. Bulk density declined with an increasing compost rate, while soil organic C increased with an increasing compost rate. The adoption of INM would boost crop productivity and soil quality.

Innovations for agroecological sustainability by rural youth; a case study

Poster

Dr. Dheeraj singh [1], ***Dr. Chandan Kumar*** [2], ***Dr. M K Chaudhary*** [3]

1. *KVK CAZRI,* ***2.*** *Subject Matter Specialist (Horticulture)KVK, CAZRI,* ***3.*** *Subject Matter Specialist(Agronomy), KVK, CAZRI*

Mr Goverdhan an innovative youth explored options for crop diversification under hot-arid conditions after being trained on basic aspects of crop diversification and natural resource management. He diverted excess runoff water into temporary rain water harvesting structure which was a big success as he could harvest enough water for raising orchards and growing winter season crop. He also increased his livestock herd to fifty for which fodder was also grown at his farm using harvested water from his pond. He also converted his farm on drip irrigation and planted 3000 pomegranate plants with teak in between. Being resourceful, he further developed innovative schemes to increase his output such as in-situ and ex-situ rainwater harvesting, taking intercrops in pomegranate orchard, fodder grass production for livestock, raising legumes for cash income and restoring soil fertility etc. Now Mr Goverdhan is a successful farmer who is also motivating others to adopt his path.

Livestock Cafés; experimental research and co-learning hubs in Dryland Transform.

Poster

Dr. Gert Nyberg [1], ***Dr. Ewa Wredle*** [2], ***Dr. Stephen Mureithi*** [3], ***Dr. Denis Mpairwe*** [4], ***Prof. Ingrid Öborn*** [1]

1. *Swedish University of Agicultural Scinces (SLU),* ***2.*** *Swedish University of Agricultural Sciences,* ***3.*** *University of Nairobi,* ***4.*** *Makarere University*

In the project Drylands Transform based in Kenya and Uganda, livestock cafés (LC's) will be the experimental ground to study forage productivity and quality in relation to references (controls) in the surrounding communal grazing grounds. These experimental plots will be managed for forage production and growth of grasses, legumes and local tree species. They will be utilized for controlled grazing or hay making by the local communities at defined times and intensities (hence the "Café" term). Restricted timing and intensity of grazing is key to management, as opposed to the open grazing. LC will be located within the Landscape Degradation Surveillance Framework (LDSF) sites and function as co-learning hubs, where researchers, local herders/farmers, extension workers, and local policy makers will discuss, exchange ideas and experiences and learn from each other in formal and informal way. As part of this, LC will pilot value-chain improvement activities and orient the communities towards value addition and local community representatives and groups will be trained on possible income generation activities and products such as grass seed, hay, honey, and other livestock products like milk. In addition to demonstrating rangeland restoration, agricultural practices supporting household nutrition, e.g. kitchen gardens will be show-cased. After the research project the LC's will be taken over by local communities, to potentially be managed as local enterprises by communities, groups or individuals.

Resource Use Efficiency and Value Chain Analysis in Smallholder Irish Potato Production in Zimbabwe: toward ecological sustainability for household food security.

Poster

Mr. Oniward Svubure [1], ***Mr. T Chapman*** [1]

1. *Chinhoyi University of Technology, Department of Agricultural Engineering, Horticulture Research Institute*

More than a billion people worldwide use Irish potatoes as food. In Zimbabwe, Irish potato is becoming an important food crop following a government declaration making it a national strategic food security crop in 2012. Increasing potato production on an ecologically sustainable basis will enable the crop to assert itself as a national strategic food security crop and help ease the food security challenges the country is currently grappling with. Efficient use of natural resources has been fundamental to agricultural practices for a very long time and should be considered together with the economic, environmental and social impact on the ecosystem that agricultural practice positively or negatively influences. Given this background, a study is proposed to investigate the totality of key resources smallholder farmers in Zimbabwe use in Irish potato production to optimise them for optimum potato tuber yield. The argument being that the levels of supply of key resources must all be close to yield-optimising levels for efficient use of resources. Improved management of water, weeds, diseases, variety selection and plant density, and other resources will most likely increase tuber yield and consequently resource use efficiency. Besides answering how eco-efficient potato production can be achieved in the smallholder sector, the study also proposes to answer how the potato industry in general can navigate itself to the next level of growth through value chain analysis.

Keywords: Irish potato, resource use efficiency, eco-efficient, value-chain analysis, smallholder farmers, Zimbabwe.

Topic 4: Closing the loop – making food systems circular

A resource flow mapping tool for rapid assessment of rural recycling opportunities

Oral

Mr. Linus Dagerskog [1]

1. *Stockholm Environment Institute*

Productive use of nutrients, organic matter and water present in the range of wastes generated on household level is an important component of sustainable farming systems. Any intervention aiming to improve such recycling needs to be based on a good understanding of the current farming and waste management system. A “Resource Flow Mapping” (RFM) tool was developed to enable a participatory diagnosis and visualization of the various wastes and their management at household level in rural communities. Participants arrange pictures and draw arrows to describe their production system, the food/feed/fuel/fibre/water products harvested, the use of these products in the household, the wastes generated and their destination. Based on this map, strengths and weaknesses can be identified and traditional and new practices can be discussed. In addition, a rating of perceived risk and resources of the different wastes is valuable to understand potential barriers and opportunities to increased and safe recycling. The RFM tool was tested with focus groups in 15 villages in Burkina Faso, and validated against household surveys (n=251). The results showed good correspondence, indicating that the focus group exercise is valid for a rapid assessment of the waste management situation in a community. It can further be used together with individual households in the implementation phase of an intervention as a sensitization tool and as a basis for action.

Food waste and circular food systems

Oral

Ms. Charity Mashegede [1]

1. *Knowledge Exchange Hub*

Despite the call by SDG target 12.3 to cut food waste and food loss by 50% by 2030, the world is still off track. In Sub-Saharan Africa, 40% of staple food is lost at the beginning of the food chain, while in industrialised countries food waste is generated at consumer level, thereby causing a significant amount of greenhouse gas (GHG) emissions. We argue that “food is never waste” and advocate for upcycling of food waste and interventions that promote circular food systems. The circular economy aims at changing the traditional paradigm of the linear economy, by improving the efficiency of all the stages of the value chain, from production to consumption and waste disposal. As the global population continues to grow, increased demand for nutrients has been predicted for coming decades and hence an alternative to conventional livestock farming that mitigates the environmental impact is needed. We propose areas of action that include changing social norms, taxing or banning landfill and scaling pilot projects such as the commercial rearing of insects to re-convert the nutrients losses back into the value chain. Insect farming can convert food waste into protein-rich human food and animal feed, while the insect frass can be converted into organic fertilizer. A recent phenomenon of interest is the farming of black soldier flies which feed on food waste and turn it into natural quality protein used in animal feed.
Keywords: Food waste, circular food systems, insect protein, value chain, black soldier fly

Human urine as a fertilizer for sustainable food systems

Oral

Ms. Aline Paiva Moreira [1], ***Prof. Paula Loureiro Paulo*** [2], ***Prof. Maria Elisa Magri*** [3], ***Prof. Björn Vinnerås*** [4]

1. *Swedish University of Agricultural Sciences (SLU),* ***2.*** *Federal University of Mato Grosso do Sul,* ***3.*** *Federal University of Santa Catarina,* ***4.*** *Swedish University of Agricultural Sciences, Department of Energy and Technology, P.O. Box 7032, SE-750 07, Uppsala, Sweden*

The rapid growth of global population together with increasing urbanization is often associated with the lack of investment in water and sanitation sector. This have resulted in pollution of water resources leading to major environmental impacts in urban areas of many countries. Therefore, new wastewater treatment technologies need to be developed for decreased pollution of the water recipients. For instance, the nutrient recovery technologies from human urine which can maximize the wastewater quality discharged into surface water, promote the green supply chain management, circular economy and urine-based bio-fertilizer. It is estimated that for one ton of urine fertilizer (one year urine from 40 people) there is sufficient organic fertilizer to 1-2 ha, depending on crop. Consequently, we can enhance resilience in the urban context and reduce of synthetic fertilizer use within crop production systems by recycling urban water and nutrients. Thereby, the energy consumption decreases, resource-oriented sanitation is enhanced and economic value is added to wastewater rest product. However, technical innovations would be needed since the productivity growth agriculture has been successful for the export trades combined with agricultural primary production. In that way, wastewater-agri-tech innovations can develop the “sustainable intensification production” and mitigate environmental pollution. In this study, the energy-sanitation-agriculture nexus is an important concept required to assess benefits and trade-offs across sectors, for this reason it is expected to present solutions based on sustainable sanitation management, through sustainability assessment studies, for alkaline urine dehydration systems installation in Brazil, in order to improve and expand the resource-oriented agro-sanitation model.

Mapping qualities and quantities of faecal sludge in Phnom Penh to enable resource recovery

Oral

Ms. Chea Eliyan [1], ***Prof. Björn Vinnerås*** [2], ***Prof. Christian Zurbrügg*** [3], ***Prof. Thammarat Koottatep*** [4], ***Dr. Kok Sothea*** [5], ***Dr. Jennifer McConville*** [2]

1. *Department of Energy and Technology, Swedish University of Agricultural Sciences, P.O. Box 7032, SE-750 07, Uppsala,* ***2.*** *Department of Energy and Technology, Swedish University of Agricultural Sciences, P.O. Box 7032, SE-750 07, Uppsala, Sweden,* ***3.*** *Department of Sanitation, Water and Solid Waste for Development (Sandec), Eawag: Swiss Federal Institute of Aquatic Science and Technology, Überlandstrasse 133, 8600 Dübendorf, Switzerland,* ***4.*** *School of Environment, Resources and Development, Environmental Engineering and Management, Asian Institute of Technology, Pathum Thani 12120, Thailand,* ***5.*** *Department of Environmental Science, Royal University of Phnom Penh, Russian Federation Boulevard, Phnom Penh 12156, Cambodia*

There is an on-going paradigm shift in the faecal sludge management and sanitation sector towards viewing human waste as a potential resource and increasingly considering resource recovery alternatives. Selecting an appropriate resource recovery alternative for local context requires accurate knowledge on faecal sludge generation, concentration of resources (e.g. water, energy and nutrients) and contaminants contained in faecal sludge. In many low-income countries, this information is not available; this is also the case for Cambodia. This study aims to determine qualities and quantities of faecal sludge generation and estimate the resources contained in faecal sludge from household in Phnom Penh. In total, 194 faecal sludge samples were collected during containment units emptying. Interviews with users and pit emptiers were conducted to collect technical data about the on-site sanitation systems. Coordination numbers of sampling households and disposal sites were also recorded. The samples were analyzed organic pollutants and plant nutrients. The high concentration of biochemical oxygen demand (BOD) and organic matters in faecal sludge make it suitable as a feedstock for biogas generation. In addition, high concentrations of nutrients in faecal sludge make it appropriate as a crop fertilizer. The recoverable biogas and nutrients from faecal sludge in Phnom Penh is calculated. The resource pathway is mapped based on the current practices. This detailed documentation of the potential recoverable resource from faecal sludge will be useful for decision-makers developing action plans for sustainable faecal sludge management in Phnom Penh and similar cities.

Keywords: Cesspit, Characterization, Onsite sanitation, Physicochemical, Septic tank

Topic 5: Innovation & Innovative Approaches

Citizen H2D3: A novel approach for (near)-real-time data-driven intelligence on diet quantity and quality

Oral

Dr. Julius Adewopo [1], ***Dr. Rhys Manners*** [1]

1. *International Institute for Tropical Agriculture (IITA)*

The triple burden of malnutrition (undernutrition, macronutrient deficiency, and obesity) is a universal problem. Globally, 817 million people are undernourished, and over 2 billion are overweight. Without data-driven intelligence on nutrition dynamics, addressing this problem is a tall order. In Rwanda, more than 37% of the population is undernourished, but recent data suggests that overweight children outnumber those suffering from hunger. Access to consistent, robust, and spatially disaggregated data on nutrition is critical to inform policies and interventions. However, national food systems are ill-equipped to generate such domain-specific in many countries, especially in Africa. Therefore, designed a user-friendly tool for rapid collection of data on citizen's household dietary diversity dynamics (Citizen-H2D3). Citizen-H2D3 leverages a gamified micro-rewards incentive to crowdsource real-time data on dietary intake from volunteers, starting with a pilot in Rwanda. Using a feature phone-based system, citizens are nudged to complete a Diet Quality Questionnaire, twice a week, at will. Citizen-H2D3 is envisioned to generate an unprecedented capacity for individuals and communities of practice to track various nutrition metrics (e.g. healthy diet indicator, dietary diversity, food frequency, minimum dietary diversity for women of reproductive age, etc) in (near-)real-time, accounting for gender, age, income, and location. The deployment and evolution of this novel tool, along with ongoing mobile revolution across most developing countries, presents a compelling opportunity to collect scalable data on nutrition and ancillary variables (such as socio-economic status) which can be translated into ground-breaking insights on consumption and diet quality dynamics, in Rwanda and beyond.

Professionalisation of Mozambican farming cooperatives through the use of appropriate digital technology and market linkages in a collaborative approach.

Oral

Mr. Matthew Mims [1]

1. *hiveonline*

In the 1970's Mozambique was the largest producer of Cashew nuts globally and yet today, after civil war, adverse policies and loss of agricultural knowledge, the country has diminished to providing just 2.1% of world production. Cashew trees have become neglected and under-productive while the market ecosystem has become fragmented. With 3.2 million smallholder farmers accounting for 95% of the country's agricultural production, coordination and education of the sector for development is challenging. In 2020, Hiveonline, in collaboration with the Mozambique Association for the Promotion of Modern Cooperatives and the NGO Norges Vel began a novel digital, ecosystem approach to grow and professionalise the sector. The project focuses on using digitisation to formalise the operations of farming cooperatives, building on data, analytics and scoring to incentivise farmers to invest in their crops, improve their yields and get access to wider markets and other forms of support. Through the creation of a virtuous cycle of growth and reinvestment, cooperatives are enabled to take on additional value added processes and become self-sustaining. Now, with over 60 cooperatives across Nampula province using the mycoop.online platform, inputting production plans, managing finances and selling their crops, farmers are able to see the returns from their collective efforts and decisions to guide their choices in future growing seasons. This study uses data and insights from the project to discuss the challenges and opportunities of deploying digital tools and creating market linkages in a multi-partner approach with rural cooperatives in Mozambique.

Uber for tractors? Digital innovations for mechanization service markets in India and Nigeria

Oral

Dr. Thomas Daum [1], ***Mr. Roberto Villalba*** [2], ***Mr. Oluwakayode Anidi*** [3], ***Ms. Sharon Masakhwe Mayienga*** [4], ***Dr. Saurabh Gupta*** [5], ***Prof. Regina Birner*** [1]

1. *University of Hohenheim,* ***2.*** *Technical University of Munich,* ***3.*** *Food and Agriculture Organization (FAO),* ***4.*** *Food and Agriculture Organization,* ***5.*** *Indian Institute of Management, Udaipur*

Digital innovations promise to enhance smallholder farmers' access to markets and services. Following the idea of Uber for ride-hailing, several start-ups have developed digital tools to enable smallholder farmers - who cannot afford to buy tractors - to access them. This promises to reduce the risks of a "mechanization divide" and enable a rural sharing economy. But while widely praised, this approach has not been rigorously analyzed. Based on case studies with Hello Tractor (Nigeria) and EM3 Agri-Services (India), we explore how these models address the thorny challenges of rural and agricultural markets and show what works, where, when, and for whom. In particular, we analyze how the approach affects the transaction costs of service markets for tractor owners and smallholder farmers. A mixed-methods approach was used, including a survey among farmers and qualitative methods (participatory mapping tools, focus group discussions, stakeholders interviews). The models reduce transaction costs for large, migratory service providers, by enabling the monitoring of tractors and operators through GPS devices. The image of smallholder farmers tapping on their smartphones to access services is not accurate as both models relied on "analog" solutions - booking agents and phone calls. Thus benefits for smallholder farmers are mostly indirect. Uber for tractors is a pioneering concept, but investment in enabling conditions, such as digital literacy and network coverage, is required to harness their full potential for smallholder farmers.

Key Words: Digital Innovations, Sharing Economy, Transaction Costs, Inclusiveness, Mechanization

Development of a ‘Wireless De-clogger’ for small-scale Drip irrigation systems.

Poster

Mr. Oniward Svubure [1], ***Mr. S Madyiwa*** [1]

1. *Chinhoyi University of Technology, Department of Agricultural Engineering, Horticulture Research Institute*

Drip irrigation is a type of micro-irrigation system that has recently gained wide-spread use among small-scale farmers in Zimbabwe. Drip irrigation has the potential to save water and nutrients by allowing water to drip slowly to the root zone of plants. The emitter openings are small making them prone to clogging thereby reducing irrigation uniformity. Chlorination can improve emitter discharges for short periods but can lower again as salts re-accumulates. Cases of farmers putting aside their systems due to chemical clogging has risen in many places in Zimbabwe. Therefore, there is a need for a system that can detect salt accumulation and notify the farmer when the concentration has reached a certain threshold. An automated system can notify the farmer on his mobile device that salts accumulation have reached the set threshold. The farmer in turn gives a command on the same mobile device to initiate de-clogging. Currently, the majority of drip irrigators apply chemicals directly into irrigation water when the system has clogged, and that no automated systems with real-time updates on salt accumulation have been introduced to them. Besides, chlorination reduces drippers clogging for a while before salts again re-accumulates. This proposed study hopes to maintain the system performance by notifying the irrigator once the salt concentration threshold levels have been reached. The irrigator will be signalled to initiate de-clogging. A constant emitter discharge/application rate will be maintained. The main objective of this study is to develop a wireless de-clogger for small-scale drip irrigation systems in Zimbabwe.

Experience with remote learning in agribusiness entrepreneurship for farmers and budding agripreneurs in Africa

Poster

Mr. Steven Carr [1], ***Dr. Anne Roulin*** [1]

1. *Agripreneurship Alliance*

Remote digital learning offers enormous opportunities to reach large numbers of people, especially those in rural areas that have few opportunities for face-to-face training. The COVID-19 crisis has provided the impetus for a big leap forward in connectivity across Africa which can be leveraged for remote training. However, there are challenges and the world-wide average for completion rates of Massive Open On-line Courses (MOOCs) is only 6%. To enhance learning and increase completion rates, it is essential to provide additional support and engage with the participants, only giving access to course materials is not enough. Building on the experience gained through the SIANI funded Expert Group, the Agripreneurship Alliance has organised on-line Entrepreneurship in Agribusiness, and Business Readiness training to young entrepreneurs in agribusiness and farmers in over 30 African countries. Completion rates of up to 70% were achieved through significant engagement with the participants. Weekly webinars were organised to explain the course materials, the tasks, provide ample opportunities for Q&A and testimonies from experienced agripreneurs. WhatsApp groups proved to be highly effective to promote peer-to-peer exchange and create the sense of community that is essential to maintaining participation and the sense of connection and community. Technoserve recently identified 4 key aspects to make remote learning impactful: Access, Credibility, Connection and Commitment. The presentation will discuss the practical implementation of these 4 key areas, the results achieved and how this contributes to SDGs: 1 No Poverty, 2 Zero Hunger, 5 Gender Equality and 8 Decent Work and Economic Growth.

FARMERS' ATTITUDES AND PERCEPTIONS IN THE ADOPTION OF AGRICULTURAL INNOVATIONS IN KENYA: A MIXED METHODS ANALYSIS

Poster

Dr. Newton Nyairo [1]

1. *Langston University*

Attitudes and perceptions are key constructs in decision making. Their nature and influence on agricultural technology adoption among smallholder farmers in Kenya has not been adequately researched. The research applied a mixed-methods approach to assess the influence of attitudes and perceptions in the adoption of agricultural innovations by smallholder farmers in Kenya. The quantitative phase used a survey (n=245) while the qualitative consisted of focus groups (n=28) to elicit subjective farmer views of innovations. A principal component analysis (PCA) technique reduced 14-attitudes statements to five conceptual clusters: challenges in accessing agricultural innovations (explained 19.09% of the total variance); effectiveness of agricultural technologies (11.88%); enjoyment of agricultural technologies (10.02%); social influence in the use of technology (9.47%); and experience with agricultural technologies (8.13%). Qualitative analysis identified key themes: farmer ambivalence about innovations; economic benefits of innovation use; ease of use of technology encouraged adoption; lack of trust; and limited knowledge of innovations. Farmers' positive evaluation of technology did not encourage widespread adoption of innovations. Farmers were found to be poorly equipped to use innovations due to limited access to agricultural information and training supporting the use of innovations. The absence of trust between the farmers and extension agents aggravated the situation.

Keywords: technology adoption; attitudes; smallholder farmers; principal component analysis; mixed methods, sub-Saharan Africa

Farmers' Knowledge of Diversity and Adaptive Plantation Patterns' Innovations for Climate Change Resilience in Iran

Poster

Ms. Maryam Eslami [1], ***Prof. Esmail Karamidehkordi*** [2], ***Dr. Afshin Tavakoli*** [3]

1. *Agricultural Extension, Communication and Rural Development Department, University of Zanjan,* ***2.*** *Agricultural Extension, Communication and Rural Development Department, University of Zanjan and Agricultural Extension and Education Department,Tarbiat Modares University,* ***3.*** *Agronomy Department, University of Zanjan*

The purpose of this paper is to investigate crop farmers' knowledge regarding diversified and adaptive plantation patterns innovations to cope with climate change and enhance their resilience and adaptation. A mixed methodology was utilised through qualitative and quantitative techniques in the Zanjan Township, located in the northwest of Iran, to collect data from a sample of 280 irrigated crop farmers. Most farmers described their experience that the temperature in their area has gradually increased in the last four decades, particularly during the winter, causing change of precipitation pattern. They also showed their concern of the continuous temperature rise in the future. The farmers to some extend knew that the increased withdrawal of groundwater, happened through increasingly deep wells drilled during the last three decades, has caused the water levels around the well to be lowered, threatening their livelihoods. The farmers showed their local knowledge on some adaptive activities and resilient mechanisms, such as changing irrigated to rainfed cropping systems, rotation, weed control, pest and weed control, vegetation and covering land during fallow, mixed cropping, etc. However, they still had shortage of knowledge regarding the cultivation of new adaptable and drought resistant plant varieties or species and methods. They also had shortage of knowledge on new adaptive irrigation systems. The results imply that the actors of knowledge and innovation systems, particularly research, extension, market and community-based institutions, should consider the adaptive and resilient approaches to define and adapt these required innovations to support farmers for the climate change challenge.

Gender-responsive farmer-led innovation for sustainable, resilient and just food systems

Poster

Ms. Chesha Wettasinha [1], ***Ms. Ann Waters-Bayer*** [2], ***Ms. Brigid Letty*** [3], ***Mr. Abdel Ali Mahamane*** [4], ***Mr. Jacob Wanyama*** [5], ***Mr. Sharad Rai*** [5]

1. *Prolinnova/ Royal Tropical Institute,* ***2.*** *Prolinnova/ Agrecol,* ***3.*** *Prolinnova/ Institute of Natural Resources,* ***4.*** *Prolinnova/ AgriBioServices,* ***5.*** *Prolinnova*

Gender-responsive farmer-led innovation is a process that strengthens the innovative capacity of small-scale-farming communities to gain food and nutrition security, ecological sustainability and community resilience. It is a novel approach to agricultural research and extension, based on farmers' motivations and ideas on how to improve local livelihoods. Identifying local innovation of women and men, individually or as groups, is an entry point to farmer-led participatory research. Local innovations include both "hard" technologies and "soft" socio-institutional innovations. "Outsiders" (scientists, advisors) observe and discover how farmers try to solve problems or grasp opportunities on their own. The "outsiders" and local community jointly assess the innovation to see whether it could indeed benefit many families in the area, particularly less advantaged ones, and would have no negative environmental or social impacts. These local innovations allow a situation analysis with farmer innovators and other community members, leading to planning farmer-led joint research and development activities. This approach encourages integration of different knowledge systems that mutually reinforce each other and lead to a wider diversity of locally-appropriate solutions. It also calls for a radical change in mindset of agricultural research and extension actors to take a supportive role and become facilitators of the process, giving women and men farmers the lead.

The Potential of cassava in the bioeconomy of Colombia

Poster

Mrs. Mónica Trujillo [1], ***Mrs. Nella Canales*** [1]

1. *Stockholm Environment Institute*

Colombia has begun implementing its National Bioeconomy Strategy and one path towards its targets is through the sustainable production of cassava, its green chemistry and circularity. This bio-resource, with origins in the Amazon, is the fifth most important crop in the country with 259.000 hectares harvested and 2.8 million tons produced (2019), mainly from small producers, associations, and small and medium-sized companies.

The analysis of the cassava value web in Colombia carried out by SEI details multiple possible uses of cassava and its market opportunities. These extend beyond the primary foodstuffs from the root and its starch consumed fresh or in baked goods in Colombia. Analysis of possible usage of the entire plant, including leaves and stems, and more complete usage of roots (peels, tips, and bran currently are largely wasted), suggest opportunities to support the biomaterials and animal feed industries. Developments in productivity, sustainability and circularity in the transformation of cassava would reduce the need for imports, as the animal feed industry currently relies heavily on imported corn and soy, while little cassava starch is available to support new biomaterials, as the bakery and food industry cannot satisfy demand without importing cassava starch.

This transition towards a circular and sustainable bioeconomy based on cassava would only be possible by implementing innovations in different areas, such as technology, business organization, public policies and incentives. These innovations must promote greater productivity without sacrificing biodiversity and also improve relations between small producers and the industry. The potential upside for Colombia is substantial.

The South Ostrobothnian model for innovative food systems

Poster

Dr. Silvia Gaiani [1], ***Prof. Sami Kurki*** [1]

1. *Ruralia Institute, University of Helsinki*

In recent times, South Ostrobothnia, a predominantly rural, landlocked region located in the south west of Finland, has been able to build its identity as the Food Province of Finland and as the best Finnish business environment. In 2018, 34% of its local enterprises were engaged in agriculture, forestry, or fishing, contributing to 10,5 % of the whole country's increment value. In 2020, 20 % of the Finnish foodstuff industry was located in the region. Statistics show that although the number of food businesses as proportion of population is high, the regional companies are smaller than average - 94.64% of all businesses are micro-enterprises -, and they have to face numerous challenges including limited supporting services, low level of local networks, expensive production costs and slight turnover. So, has the region been able to affirm itself as an innovative region despite a number of evident hurdles? In our contribution, we provide insights on the South Ostrobothnian peculiar food innovation model, which can be described as a combination of 1. *a closed innovation approach,* as the innovation process takes place mostly within the companies and know-how, technology, processes and intellectual property remain under companies' control 2. *a strength-based approach*, which is grounded in the enhancement of individual, organizational and regional strengths, and 3. *efficient regional policies*. Our suggestion is that this regional model can be adapted elsewhere so to unlock bottlenecks and foster food systems innovation for localized impact.

Towards intermediacy reduction in agrochemical market; Nigeria Farmers mobile phone usage potential, a case study of Arable farmers of Oyo state. Nigeria

Poster

Mr. adesanlu ayorinde [1], ***Mr. Taiwo oludare*** [1], ***Mr. Hamzat olatunji*** [1], ***Mr. Sodeeq A.E*** [1]

1. *federal college of animal health and production technology,Apata,Ibadan,Nigeria*

keywords; Involvement, intermediacy, market information, agrochemical inputs,mobile phone usage frequency, trend, purpose, benefits

Farmer's poor access to market information has most often necessitated duplication of layers of intermediacy in input market. This has ensures that farmers avoidably pay more for daily needed products on their farm. Exploring farmers poor market information, middlemen crop up at every instance of enquiry for inputs, mostly agrochemicals such as fertilizers, herbicides, pesticides and insecticide. This has made sure cost of farming are kept high, eroding their little profit and worsening their poverty status, this discourage farming and complicate the already stressed food security of the people.

Leveraging on the ability of mobile phone to reach even the most remote of farmer and its opportunity for information dissemination, this study used a well-structured questionnaire to collect data from a selected sample of arable farmers in Oyo state, Nigeria. Assessing their mobile phone usage trend, frequency and purpose in their day-to-day involvement with intermediacy in agrochemical market in their source for input. The potential of mobile phone usage in limiting intermediacy is then tested on the extent of involvement of farmers with middlemen. The result indicated that mobile phone usage significantly reduce farmers involvement with middlemen as the more their frequency and trend of usage, as well as agricultural purpose of usage, the less the less their involvement with intermediary becomes. The influence of the usage is also significant on the income of the farmers.

Topic 6: Build resilience to vulnerabilities, shocks and stress

A Land-Atmospheric tele-connection analysis of the interactions of Rainforests and Agricultural Production in Africa

Oral

Mr. Maganizo Kruger Nyasulu [1], ***Dr. Ingo Fetzer*** [1], ***Dr. Lan Wang-Erlandsson*** [1], ***Dr. Fabian Stenzel*** [2]

1. *Stockholm Resilience Centre, Stockholm University,* ***2.*** *Potsdam Institute of Climate Impact Research*

With over 90% rainfed agriculture, rainfall is essential for food security and livelihoods in sub- Saharan Africa. In some regions, up to about 50 % of rainfall comes from the Congo rainforests. Through evapotranspiration, these rainforests supply a considerable amount of moisture (vapour) to the atmosphere, which is transported as atmospheric moisture to provide downwind near or remote agricultural land with rainfall. This process where terrestrial evaporation re-precipitates on land is called moisture recycling (Savenije, 1995). Ongoing deforestation and Climatic changes lead to direct cause-effect and indirect spillover effects at the teleconnection regime. These indirect effects are difficult to analyse than the direct effect. Here, we examine the land-atmospheric teleconnections by applying integrated moisture tracking analysis, and a dynamic global vegetation model (LPJmL). We find that rainforests as regional rainfall suppliers increases strongly during dry seasons. While most of the rainforests primarily occupy the Democratic Republic of Congo, many of their neighbouring countries located west of Congo rainforest, which have more than 95% rainfed-agriculture dependence for their food production, have a stake in the rainforest as they heavily rely on forest moisture for their rainfall. In these countries, more than 40% of forest-precipitation contribute to water consumed by agricultural crops, with countries like Equatorial Guinea and Gabon relaying even entirely of forest-precipitation. In view of ongoing deforestation and climate change, and the implications for forest resilience and agricultural production, we conclude that the temporal variation in moisture recycling constitutes an important feature to consider in forest and moisture recycling governance.

A wealth of soil: Social-ecological traps, economy and resilience on Finnish farms

Oral

Ms. Hanna Nikkanen [1]

1. *Stockholm Resilience Centre*

Food systems are facing increasing pressure to adapt to the local, regional and global implications of the climate crisis while reducing the environmental impacts of food production and retaining their competitiveness on increasingly connected agri-food markets. Many suggested aspects of a more resilient, sustainable model of food production are directly linked to decisions made on individual farms. However, there are known social-ecological traps that limit farmers' capacity to break away from unsustainable paths. This mixed-method study investigates the impact of trap dynamics and shocks on the incidence of sustainability transitions on Finnish farms – for example, transitions from animal to plant agriculture, or from monoculture to crop diversity. I use national tax records and interviews with regenerative farmers to identify patterns and circumstances that preclude farmers' ability to carry out sustainability transitions, and to describe strategies used by regenerative farmers to enhance their farms' resilience and avert traps. My findings indicate that an increasing burden of farming debt converges with rigid governance and market structures, policies promoting larger farm sizes and mechanization, a global pattern of food system financialization and intensifying ecological pressures and creates, sustains and exacerbates social-ecological traps. These traps make it difficult for many Finnish farmers to leave undesirable trajectories behind. Transitions from animal husbandry to plant agriculture appear particularly challenging. Any future attempts to transform food systems will have to account for the mechanisms that block farm-level initiatives. They will also have consider the limited options available to indebted farmers who are continuously dealing with shocks.

African Water Resource Potential for Agricultural Production: A Hydroclimatic Regime Assessment

Oral

Mr. Maganizo Kruger Nyasulu [1], ***Prof. Dieter Gerten*** [2], ***Prof. Johan Rockström*** [2], ***Dr. Ingo Fetzer*** [1]

1. *Stockholm Resilience Centre, Stockholm University,* ***2.*** *Potsdam Institute of Climate Impact Research*

There is an unprecedented challenge to sustain feeding the growing population in Africa in the coming 30 year or more, where the required food production has to scale by 70%, thereby increasing consumptive water yearly. However, in sub-Saharan Africa, the human-water interaction in agriculture is limited to studies adapted from global assessment, or from the river basin, restricting equally important the dry-subhumid, wet-subhumid, and semiarid regions which occupy the majority of Agricultural important zones of Africa. This knowledge gap limits the understanding of the potential of these regions in closing yield-gap vis-à-vis the development of favourable water governance. SImilary there is a luck of continental assessments of both future projections and plant water management. This study aims at categorizing landscape units based on the dominant flows of blue and green water (Weiskel et al., 2014), with the aim of (1) quantification of blue-green water at different hydroclimatic regimes; (2) Assessment of variability for agricultural consumption to produce an Average Dietary energy requirement (Gerten et al., 2020). (3) account which hydroclimatic zones have the capacity to contribute towards closing the yield gap at a global scale and local (African) food self-sufficiency (FSS). Our findings show that hydroclimatic regimes of green and blue water sink have the capability to close the yield gap within their regime and likewise support demands in water source regimes. While there are gaps in other hydroclimatic regimes of source, transformative governance on green water can play a huge role in increasing water productivity in food production.

Building Organizational Resilience for Food System Transformation during COVID-19 Pandemic: The Case of Extension System in Nigeria

Oral

Dr. Ifeoma Anugwa [1], ***Dr. Suresh Babu*** [2], ***Prof. Agwu Ekwe*** [1]

1. *University of Nigeria Nsukka,* ***2.*** *International Food Policy Research Institute*

Feeding and nourishing the growing world population in the face of current COVID-19 pandemic increases the need for speedy transformation of global food system. Transformation of the food system at the national level requires strong organizational and human capacity. Extension services can help build resilience of food systems and strengthen national agricultural innovation systems needed to support food system transformation. However, public extension services in developing economies like Nigeria continue to face challenges that could undermine food system transformation. Using the public extension system in Nigeria as the case study, we studied potential changes in the extension system that could contribute to food system transformation during the COVID-19 pandemic. Document reviews, focus group discussion and key informant interviews were used to achieve the study objectives. Kaleidoscope Model was used as a diagnostic framework to identify factors affecting the capacities of the extension system to support food system transformation optimally during the COVID-19 pandemic, whereas key informant interviews and focus group discussions were used to identify the solutions. Results of the study show that COVID-19 pandemic exposed the vulnerability of the already weak extension system such as inadequate funding, supply-driven information flow, poor linkages with relevant stakeholders, among others . In order to address the organizational challenges of public extension system and build its resilience to future shocks, we make specific recommendations including policy interventions to ensure adequate funding, improved human capacities, strengthened linkages between extension and agricultural research systems and digitalization of extension services.

Climate Change and Maize Production in Zambia: Time Series Analysis

Oral

Mr. Byrne Kaulu [1]

1. *Copperbelt University*

There has been increased call for prioritising climate change on world development agendas. Extant literature argues that changes in our climate influence agriculture in general. In the case of developing countries like Zambia in Sub-Sahara Africa, maize is a staple food. However, studies on the effects that climate change has on maize production in Zambia are inconclusive. Many do not adequately quantify the short and long run effects of climate change on maize production. The current study uses time series analysis to model the quantitative long and short run relationships between climate change and maize production in Zambia. It uses data from 1961 to 2018 to assess questions such as: What are the short run relationships between climate change and maize production in Zambia. How does climate change influence maize production in the long run? What are the causal relationships between climate change and maize production in Zambia? The results of this study are useful for influencing agriculture, energy and climate change policy that help build resilience to vulnerabilities in maize production.

Climate change mitigation through community managed conservation: a case study from arid zone of Pali, India

Oral

Dr. Dheeraj singh [1], ***Dr. M K Chaudhary*** [2], ***Dr. Chandan Kumar*** [3]

1. *Principle Scientist and Head, KVK ,CAZRI,* ***2.*** *Subject Matter Specialist(Agronomy), KVK, CAZRI,* ***3.*** *Subject Matter Specialist (Horticulture)KVK, CAZRI*

Today the communities are experiencing extreme temperatures and prolonged drought. This suggests the need to support initiatives such as local landrace promotion, community conservation and adaptation. Keeping the above facts in view a research was conducted in Pali, India with a view to evaluate the farmer's perception about conservation and propagation of *kharchia* wheat in semiarid zone under saline conditions. *Kharchia*wheat indigenous to Kharchia village of Rajasthan India was chosen as the crop for survey as it is undoubted and universally recognized as highest salt tolerant wheat genotype. The results show that most of the farmers (92%) feel that growing this is inevitable because this is the only variety which can adapt to harsh conditions of saline soil, saline water and high temperature and can still give some yield. Majority of the farmers (94%) grow this land race as the seed viability is very high and can be used for cultivation for years together. besides other characteristics farmers (93%) are of the opinion that in addition to the grain yield, the fodder yield is also high. Almost all the farmers (99%) were of view that this landrace is more tasty, nutritious and has lot of medicinal properties. As this wheat absorbs lot of water during processing ,the products made from this wheat were soft and can be kept fresh for long duration as compared to improved varieties. Thus, the farmers are using traditional varieties and knowledge to adapt to climate change, particularly where traditional farming systems have been maintained.

From self-sufficiency to vulnerability: policy developments and land-use shift in contemporary Sweden

Oral

Ms. Rebeca Borges [1]

1. *Friends of the Earth Sweden*

The paper analyses Sweden´s lack of self-sufficiency in the food supply as a symptom of underlying policy developments that have shifted land use. These have been considered "radical," entailing a "system change" and were adopted in a short period of time; factors that fuelled a conflict with small-scale farmers, who claim that the Swedish State is systematically eradicating their livelihoods in the pursuit of an export-led economy. Power relations tend to make the conflict invisible, so the question is *how does political ecology studies contribute to the definition, and therefore, recognition and visibility, of the conflict over land in contemporary Sweden?*The framework used is the theory of accumulation by dispossession to identify the mechanisms that constitute and reproduce the conflict in question; conflict studies offer an analysis of the case on its levels of *dispute*, *underlying conflict*, and *deep-rooted conflict*. It is concluded that a) the policy changes entailed re-commodification of land and food; b) Sweden's vulnerability is discretionary as part of the paradigm of free trade in which dependency is required; c) the recognition of this conflict over land in Sweden indicates that democratic and wealthy countries are subjected to similar land-grabbing processes happening in the Global South; d) the self-sufficiency paradigm is desirable to shift the Swedish food system from wasteful to sustainable; e) solutions lie in policy changes to be made based on reconciliation, and political ecology studies help define the conflict and identify its key elements, offering the next step towards that reconciliation.

Recovery and building resilience during and after pandemics: How gender-responsive are the policy measures?

Oral

Dr. Linda Etale [1], ***Dr. Ranjitha Puskur*** [1], ***Ms. Avni Mishra*** [1], ***Ms. Rohini Mohan*** [1]

1. *International Rice Research Institute*

The COVID-19 pandemic has exposed the fragility of food systems and the vulnerability of low-income populations and women in developing countries. Containment measures by governments restricting movement have disrupted food supply chains, access to staple food markets, farm inputs, and agriculture-based livelihoods. The place of women in agriculture and food systems as a crucial resource is undeniable even as they face the constraints that reduce their productivity, including those associated with the COVID-19 pandemic. A collaborative study by the CGIAR Generating Evidence and New Directions for Equitable Results (GENDER) Platform and the Food and Agriculture Organisation on gender responsiveness of COVID-19 related policy responses in agriculture in Senegal, Zambia, and Ethiopia suggest that women, especially female-headed households are more vulnerable to the shocks related to the COVID-19 pandemic. Gender-neutral policy responses have increased the vulnerability of women's agricultural-based livelihoods. The knock-on effects of COVID-19 on gender equality and women's empowerment efforts in food systems are indisputable. It calls for fiscal measures including tax reduction and debt relief to agricultural women entrepreneurs especially those with low collective action, to access resources and markets. Implementation of social protection measures through social groups to identify and protect the most vulnerable women can cushion women's income and enterprise loss. Holistic policy measures encouraging skills development and group savings could improve or stabilize income, food security, and reduce vulnerability to shocks. It is also critical that governments design asset-building or asset support measures to be gender-responsive during the design and implementation of emergency responses.

Restoring drylands for nutrition and health of humans and livestock

Oral

Prof. Ingrid Öborn [1], ***Dr. Aida Bargues Tobella*** [2], ***Dr. Göran Bostedt*** [3], ***Prof. Agneta Hörnell*** [4], ***Dr. Per Knutsson*** [5], ***Dr. Kristina Lindvall*** [4], ***Dr. Denis Mpairwe*** [6], ***Dr. Stephen Mureithi*** [7], ***Dr. Gert Nyberg*** [8], ***Dr. Ylva Nyberg*** [3], ***Dr. Barbara Schumann*** [4], ***Dr. Alice Turinawe*** [9], ***Dr. Tor-Gunnar Vågen*** [10], ***Dr. Dereje Wakjira*** [11], ***Dr. Jeff Wamiti Muthui*** [7], ***Dr. Leigh-Ann Winowiecki*** [10], ***Dr. Ewa Wredle*** [12]

1. *sl,* ***2.*** *Dept of Forest Ecology and Management, SLU,* ***3.*** *Swedish University of Agricultural Sciences (SLU),* ***4.*** *Umeå University,* ***5.*** *University of Gothenburg,* ***6.*** *Makarere University,* ***7.*** *University of Nairobi,* ***8.*** *Swedish University of Agicultural Scinces (SLU),* ***9.*** *Makerere University,* ***10.*** *World Agroforestry (ICRAF),* ***11.*** *Intergovernmental Authority on Development (IGAD),* ***12.*** *Swedish University of Agricultural Sciences*

Drylands cover 40 % of the global land area, host 2 billion people and support ~50% of the world's livestock population. In the drylands of East Africa, pastoralism and agropastoralism are the main livelihood systems, largely depending on seasonal migration. Drylands Transform is a transdisciplinary research project implemented in the Karamoja cluster (Kenya, Uganda) where we will investigate the links between land health, livestock-based livelihoods, human well-being, and land management and governance. We will contribute with new knowledge for transformative change and sustainable development of semi-arid rangelands. These areas face severe land degradation, low agricultural productivity, rapid population growth, widespread poverty, and poor health. Governance structures and institutions are weak. Livestock keeping communities and their land are highly vulnerable to climate shocks, while there are also changes in land tenure, insecurity/conflicts and rapid infrastructure development. Through strong stakeholder engagement, we explore challenges and pathways towards a social-ecological transformation. Drylands Transform is revolving around the Sustainable Development Goals (SDGs). Our entry point is the urgent need to identify and enhance synergies between food and nutrition security (SDG2), land and ecosystem health (SDG15) and governance and justice (SDG16) for sustainable dryland development, aiming to improve health and equity (SDGs3,5), while minimizing trade-offs between agricultural productivity, natural resources management and climate change. We apply innovative field research approaches focusing on livelihood improvement through rangeland restoration and governance interventions. In the session, we will present the research framework and partnership, the study sites and the initial results and plans ahead.

Building resilient systems in risk prone communities.

Poster

Mr. Perez K Katambala [1]

1. *Knowledge Exchange Hub*

Population growth and urban-rural migration has forced individuals to utilize otherwise reserved forest areas in the hilly and mountainous terrains which are well leached and rich in micronutrients. In the process of land reclamation, plants with deep root systems are cut to provide timber and energy for cooking and are not replaced with similar plants but with fast growing perennial cash crops, with surface fibrous root systems which do not hold up soil together. This has led to poor soil cohesion escalating cleavage, leading to mudslides and avalanches during rainy seasons putting lives and property at risk. Governments have relocated individuals living in such areas to safer ones within the country but due to cultural barriers and poor economic opportunities, they are forced back. This has called for innovative approaches that can mitigate the related risks to help people in such communities produce food safely and thrive economically. We are proposing alluvial gardening system, a technology where uphill rainwater is harvested for agriculture production like gardening or fish farming. This will also promote proper water management for continuous agriculture production and empowerment of community extension agricultural technical personnel. These will inform farmers when to expect heavy rainfalls using accurate internet based weather prediction technologies through telephone apps. Which crops to plant that economically beneficial which can create safe terrace system and help in land conservation, mulching techniques, soil nutrient reservation, landslide risk mitigation and how to preserve harvested food crops tailored for such areas.

Climate Smart Farming Technique

Poster

Mr. Abiodun Kila [1], ***Dr. Gbemisola Ogunnaike*** [2], ***Dr. Oladele Oladeji*** [3]

1. *Continuum Multiservices Global Enterprises,* ***2.*** *Olabisi Onabanjo University, Ogun State,* ***3.*** *Federal University of Agriculture, Abeokuta, Ogun State*

Climate change and ecological degradation has affected smallholder farmers globally.The only way to ensure sustainable food production systems that are resilient to environmental disruptions is to adopt climate smart agricultural practices and start handling farmlands as complex webs of ecological interactions as opposed to the most prevailing conventional practices where farm production is conceived as linear systems in which inputs (such as acreage, fertilizer) influence outputs (yields).
Moreover, the need to rise up to the challenge of feeding the rapidly growing population in Africa, while not compromising resource and environmental sustainability in the face of climate change, makes it imperative that Africa's agriculture is transformed, hence the call for a shift to Climate Smart Agriculture.
The research questions are;

- How to mobilize, empower and incentivize smallholder farmers (SHFs) into adopting climate smart agricultural practices?
- What are the existing frameworks and networks for adoption of climate smart agricultural practices in Nigeria?
- How to promote and facilitate knowledge acquisition on foreign export markets, food/crop quality standard requirements from the farm level, international trade regulations and standards for farm produce?
- What are farmers' awareness, perceptions, skill levels and adoption rates of various CSPs available in South West Nigeria; dis-aggregated by gender, age, and other socio-cultural and economic groups?
- What are the cost, returns and production efficiencies associated with adoption of various CSPs in South West Nigeria as well as the socio-economic impacts in terms of employment generation, poverty reduction, food security and women / youth empowerment?

Conserved Moisture to Cash: Lesson from an Autonomous and Opportunistic Agroecological Adaptation in Arid Climate of Rajasthan, India

Poster

Dr. Dheeraj singh [1], ***Dr. M K Chaudhary*** [1], ***Dr. Chandan Kumar*** [1]

1. *KVK CAZRI*

Resource scarcity and exposure to multiple stressors have compelled small holder subsistence farmers' world over to develop location specific knowledge and adaptation strategies to sustain their livelihoods in risk-prone ecosystems. Study carried out in Pali district of Rajasthan, India indicated that majority of over 84.0% farmers are experiencing delayed monsoon, erratic rainfall, high temperature and early recession of rains. To adapt these multiple stressors and sustain their livelihoods, farmers have developed location specific agroecological knowledge to utilize the conserved soil moisture in Hemawas dam. The stress of climate variability and salinity substituted other cereals with muskmelon as opportunistic adaptation by majority of small farmers as this is a three months cash crop, cultivated with least external inputs and moderate vulnerability. In the land freed from water farmers grow muskmelon in the conserved moisture during last week of February. They simply plough the land to open up the soil and then manual sowing is done in the open spaces using local landraces specially treated with luke warm water and kept in moist jute bags overnight for easy germination. This adaptation is continued when farmers have zero competition with other agricultural enterprises and related activities. The farmers plank the field when the seeds germinate and attain 2-3 weeks age to trap the moisture and level the field. This also control the insects harming the crop by sealing the soil. This study provides an insight about how formal and informal knowledge can be hybridized to co-produce more robust adaptation against multiple stressors.

DRIVERS OF CLIMATE CHANGE VULNERABILITY STATUS AMONG FARMING HOUSEHOLDS IN A RURAL AREA OF NORTH CENTRAL NIGERIA

Poster

Mr. Simon Peter Osagede [1], ***Prof. Ibrahim H.Y*** [2]

1. *Department of Agricultural Economics and Extension, Nasarawa State University Keffi, Nigeria,* ***2.*** *Department of Agricultural Economics, Federal University Dutsin-Ma, Katsina State, Nigeria*

Using a sample of 100 randomly sampled farming households, the study determined climate change vulnerability status and its drivers in a rural area of north central Nigeria. Data were collected with the aid of structured questionnaire and analyzed using descriptive statistics, Climate Change Vulnerability Index, Principal Component Analysis and Ordinal Logit Regression. Flood, pest and disease outbreak, inadequate rainfall, crop failure and erosion were the major climate related events observed in the study area. In terms of climate change vulnerability status, a little above half (57.0%) of sampled households were classified as highly vulnerable to climate change. The remaining 25.0 % have a moderate vulnerability, while only 18.0 % have a low vulnerability to climate change. The major factors driving climate change vulnerability include; age of farmers, amount of credit, income, dependency ratio, commercialisation index, crop diversity and total input cost. The study concluded that the farming systems in rural areas of north central Nigeria are vulnerable to climate change. As a result, major disruptions at the core foundation of the food system are imminent. The study recommended an increase in investments on climate change advisory services for rural farming households to reduce vulnerability to climate change and prevent a major food emergency

Institutional Quality in Disaster Preparedness, Response and Recovery to Delivery disaster risk management Products and Services

Poster

Mr. Donald Ferdinand Okere Atanga [1], ***Dr. Jean-Claude Bidogeza*** [2]

1. *Dschang University,* ***2.*** *International Fund for Agricultural Development*

Natural disasters are considered to be natural hazards whose different phases affect the development process of states. When they occur violently and affect people's livelihoods, they become natural disasters. Predisposition to suffer the consequences of natural disasters depends on a set of conditions that influence the ability of people and government to anticipate, cope with, resist and recover from the impact of a natural shock. Therefore, the key to improving such conditions lies in preparing for hazardous weather events and preventing natural disasters rather than mitigating their consequences. Are economies with good institutions less affected by calamities due to natural disasters than relatively less well-endowed economies? A wide range of empirical studies have answered in the affirmative that quality of institutions is determinant in the provision of public goods and services in the aftermath of natural disasters. As regards empirical approaches to the political economy of natural disasters, these are dominated by case studies, with limited work on individual countries or regions of the world. Using data from Centre for Research on Epidemiology of Disasters, World Development Indicators, World Governance Indicators and World Risk Report, this study aims to assess the effects of institutions on the preparedness, responses and recovery to delivery of disaster risk management products and services. Our results show that corruption, poor quality of the bureaucracy and poor rule of the law do not reduce the number of victims of natural disasters in Africa.

Participatory Guarantee Systems: Agroecological Certification to Enhance Smallholder farmers' Adaptive Capacity to Climate Change

Poster

Mr. Pablo Urbina [1]

1. *Technische universität Dresden*

Food production is behind the success of developed nations. Once the food issue is solved, human and financial resources can be allocated to address other areas of development. But since the advent of the green revolution, the food production system has proven to be a major driving force of environmental change. Additionally, climate change poses serious challenges to an already vulnerable food production system, with more frequent extreme weather events reducing crop yields. Therefore, a transformation of the food production system is necessary that can guarantee foodstuff for nations constantly and effectively whilst in harmony with the earth system. Participatory Guarantee Systems are alternative mechanisms for regulating food production standards adapted to smallholders. Using a case study approach comparing two PGS from Peru, this article highlights their contribution to strengthening farmers' adaptive capacity to climate change by empowering farmers, enhancing their food security and market access, and stimulate the implementation of agroecological practices. Secondary data was collected to analyse smallholders' implementation of agroecological practices, this was complemented with interviews with smallholders of both PGS to qualitatively assess empowerment, enhanced food security, and enhanced market access. The analysis shows that farmers keep on implementing agroecological practices year after year to get a certification, improving their practices based on inspectors' recommendations. The results from the interviews show farmers have access to more information on agricultural practices, make better decisions about their farm management, have a sustained food production through the year, and sell their agricultural products easier with a certification.

RESILIENCE OF SOME AFRICAN AGRARIAN SYSTEMS

Poster

Mr. GEAR KAJOBA [1]

1. *University of Zambia*

This abstract is about on- going research on resilience of some African agrarian systems. It builds on ecological surveys conducted in Zambia at colonial interface; analyses government agricultural statistics, and field data, showing that resilience is based on the incorporation of sustainable land use practices like crop rotation, use of cattle and green manure and legumes to sustain soil fertility, and use of wetlands for irrigated farming. These were and continue to be the basis of crop diversification that includes cereals, root crops, legumes, cucurbits, vegetables, fruit and livestock, plus fishing.These foods can be incorporated into value chains by agro-processing of cereals like sorghum and millet to make them available in supermarkets, as breakfast cereal and as infant feeding foods to reduce malnutrition, build household food security, nutrition and resilience. Resilience can be enhanced through interfacing indigenous and scientific knowledge systems, especially if governments, the scientific community, the private sector and academic research institutions intervene to produce hybrid seed (and livestock) varieties that are early maturing, drought tolerant, high yielding, palatable and nutritious, to feed the expanding youthful population, and adapt to climate change. Innovation in mindsets is needed, to create an exit option through industrialization. A smaller proportion of the population, should become commercial farmers, while the rest of the surplus rural population is absorbed in industries, mines, trading, services, and entrepreneurship.

Key words: resilience, African agrarian systems, industrialization.

Should We Prioritize the Soil-based Precision While Recommending a Cover for Climate Resilience?

Poster

Dr. Reshmi Sarkar [1], ***Mr. Javid McLawrence*** [1], ***Dr. Anil Somenahally*** [1]

1. *Texas A&M AgriLife Research*

With climate change and increased drought stress, vulnerability of small-scale farmers are increased. Introducing a cover during spring or winter has plausibility to improve soil-health and sustainability of agroecosystems. However, farmers still believe that an extra crop to keep the land covered would decrease the moisture level in soils for upcoming summer crops. But, to build resilience and minimize losses from climate stressors, climate-resilient conservation and regenerative practices which are being recommended regionally are not always suitable for smallholders. As smallholders are the prospective farmers worldwide to meet the global sustainability goals and at the same time they are the most vulnerable to climate stresses, we must shift towards precision practices especially soil-based cover. Our hypothesis was small farms should have précised conservation practice recommendations as soil textural variability especially clay+silt content varies carbon sequestration (CS), water availability and drought resilience of an agroecosystem. We found modulations in CS and moisture in subsurface-soil layers as interaction-effects of cover, soil depth and inherent characteristics of two similar but different soil-profiles. Nitrogen-uptake and biomass productivity based on rainfall was impacted by both soil-covers and nitrogen-sources either biological (from legumes and manure) or synthetic (fertilizers). Water availability in subsurface and subsoil layers varied not only based on silt +clay content of the soil layers of similar soil profiles, also due to the consequent effects from biogeochemical reactions, C turn over and litter accumulation on surface soils. While efficacy of a cover also was found different when analyzed for drought-prone years and in long-term.

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