

# Rural transformation and urbanization

Agricultural research for development  
Agri4D conference 2017



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Swedish University of Agricultural Sciences, SLU  
Uppsala, Sweden

*Agri*4D



# ABOUT

Rural populations, still a majority in developing countries are usually marginalized and living in poverty. These small-scale farmers support one third of the global population. Agenda 2030 focuses on eradicating poverty by 2030, and on “leaving no one behind”. A crucial focus must be the rural poor who depend on agriculture and related services for their livelihoods.

There is today a rapid migration of the rural poor to swelling urban centres in search of better job opportunities and improved livelihoods. A large part of these rural migrants succeeds in finding better life, but for many the hopes of a better future often turns into a nightmare of economic and social insecurity. Rural-urban linkages may have a positive impact on the rural poor connecting them to economic incomes and development opportunities. A rural transformation linked to pro poor inclusive growth and urban dynamics can thus be a critical component of sustainable development as a whole.

Key to reaching the goals of Agenda 2030 is Rural transformation, which is about social and economic transformation going hand in hand within the framework of environmental boundaries. The IFAD 2016 Report points to increased productivity of agricultural production as a crucial element to reach an inclusive rural transformation, as there is a tremendous gap between the most productive and the least productive of small holder farmers. In order to achieve this, we need improved health and education as a base, and access to water, inputs, markets, value chains and knowledge. We also need systems to avoid food losses, a secure access to land, and basic credits, and measures for adapting to and mitigating climate change. All these elements are at our hands but must be coupled with social and political transformations.

Swedish University of Agricultural Sciences (SLU) and Swedish International Agriculture Network Initiative (SIANI) are pleased to announce the Agri4D 2017 Conference. This is a two day event for researchers and professionals working with and/or interested in agriculture for development. Master and PhD students, senior scientists, experts from social, political, soils, crops, natural resources and animal science, economy, forestry, horticulture, veterinary medicine etc. are encouraged to participate.

## Keynote speakers and sessions

- Antony Chapoto, Indaba Agricultural Policy Research Institute (IAPRI), Zambia
- Pay Drechsel, International Water Management Institute (IWMI), Sri Lanka
- Nighisty Ghezze, International Foundation for Science (IFS), Sweden
- Thomas S Jayne, Michigan State University (MSU), USA
- Dave Little, University of Stirling, United Kingdom
- Luc Mougeot, International Development Research Centre (IDRC), Canada
- Bimbika Sijapati Basnett, Center for International Forestry Research (CIFOR), Indonesia
- Ingrid Öborn, ICRAF and SLU, Sweden

We will have three parallel thematic sessions on each day of the conference. The poster session will open on the first day.

**For more information visit us at:**

[www.siani.se/event/Agri4D2017](http://www.siani.se/event/Agri4D2017)

 #Agri4D17



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WEDNESDAY 20 SEPTEMBER

- 08.15 Registration and coffee
- 08.45 Welcome by organizers, and opening message by Anna-Maria Oltorp, Head of Sida's unit for research cooperation. Moderator Annika Åhnberg.
- 09.00 Keynote speeches
- **The Rise of Medium-Scale Farms in Africa: Causes and Consequences of Changing Farm Size Distributions.**  
*Thomas Jayne, Michigan State University, USA*
  - **Diverse aquaculture and its societal impacts-roles of South-south learning.**  
*Dave Little, University of Stirling, UK*
- 10.15 Coffee break
- 10.45 Keynote speeches
- **Towards Sustainable Land Use: Challenges and opportunities.**  
*Ingrid Öborn, ICRAF and SLU, Sweden*
  - **Addressing gender and rights in forestry sector: Lessons from CIFOR's research in developing countries.**  
*Bimbika Sijapati Basnett, CIFOR, Indonesia*
- 12.00 Lunch
- 13.00 Poster session
- 14.15-17.15 Thematic sessions
- **Land - under pressures or dynamic changes?**  
*Session leaders: Ewa Wredle, SLU, Sweden; Madelene Ostwald, GMV (Chalmers/GU) and Linköping University, Sweden; Ingrid Öborn, ICRAF and SLU, Sweden*
  - **Forests for Food Security – in the light of Equal Rights and Sustainable Resource Management.**  
*Session leaders: Malin Gustafsson, Focali/GMV, Sweden; Jenny Friman, University of Gothenburg (GU), Sweden*
  - **Fish farming for food security, nutrition and poverty reduction.**  
*Session leaders: Anders Kiessling, SLU, Sweden; Anna Norman Haldén, SLU, Sweden*
- 15.30-15.45 Coffee break
- 17.15-19.00 Reception (mingle)

# DAY 2

## THURSDAY 21 SEPTEMBER

- 08.15 Coffee
- 08.45-12.00 Thematic sessions
- **Knowledge Based Bioeconomies – Tools for Agricultural Transformation and Rural Development.**  
*Session leaders: Ivar Virgin, Stockholm Environment Institute (SEI), Sweden; Antony Chapoto, IAPRI, Zambia*
  - **Water in Transforming Landscapes.**  
*Session leaders: Lotta Samuelson, Swedish Water House (SIWI), Sweden; Kristina Johansson, SIWI, Sweden; Anna Tengberg, SIWI, Sweden; Nighisty Ghezae, IFS, Sweden*
  - **Urban and peri-urban agriculture, livelihoods, and food and nutrition security in the Global South.**  
*Session leaders: Magnus Jirström, Lund University (LU), Sweden; Beatrix Alsanius, SLU, Sweden*
- 10.30-11.00 Coffee break
- 12.00 Lunch
- 13.00 Welcome to Day 2 by Moderator Marika Griehsel
- 13.15 Keynote speeches
- **Empowering developing countries: Developing the scientific capacity of young researchers to tackle global challenges.**  
*Nighisty Ghezae, IFS, Sweden*
  - **Sustainable Poverty Reduction: The market and economics of emerging bioeconomies in Sub Saharan Africa.**  
*Antony Chapoto, IAPRI, Zambia*
- 14.15 Coffee break
- 14.45 Keynote speeches
- **Urban Agricultures Without Borders: Lessons, Logics and Liabilities.**  
*Luc Mougeot, IDRC, Canada*
  - **Urban Agriculture between Urban Phenomenon and Urban Legend: Perspectives from Research in Africa.**  
*Pay Drechsel, IWMI, Sri Lanka*
- 15.45 Panel discussion with keynote speakers. Moderator Marika Griehsel
- 16.45-17.00 Closing of the conference



# SHORT BIOS OF KEYNOTE SPEAKERS



## **Antony Chapoto**

INDABA AGRICULTURAL POLICY RESEARCH INSTITUTE (IAPRI), ZAMBIA

Dr. Chapoto joined the Indaba Agricultural Policy Research Institute (IAPRI) in July 2014 as the Research Director from the International Food Policy Research Institute (IFPRI) where he was a Research Fellow under the Development Strategy and Governance Division based in Accra, Ghana with IFPRI's Ghana Strategy Support Program. Prior to IFPRI, Dr. Chapoto was an Assistant Professor for 5 years and 1 year as an Associate Professor in the Department of Agricultural, Food, and Resource Economics at Michigan State University stationed in Zambia under the Food Security Research Project in Lusaka, as the USAID Chief of Party and Research Coordinator. His research interests focus on agricultural development issues in Africa, including agricultural technology and productivity, smallholder farm commercialization, home-grown medium and large-scale farmers and food markets and policy. Dr. Chapoto has a PhD in Agricultural Economics from Michigan State University and a Masters in Agricultural Economics from the University of Zimbabwe.



## **Pay Drechsel**

INTERNATIONAL WATER MANAGEMENT INSTITUTE (IWMI), SRI LANKA

Pay Drechsel holds a PhD in Environmental Sciences and is a principal researcher and research program leader at the International Water Management Institute (IWMI), CGIAR. With 25 years of professional experience, Pay has been working extensively in the rural-urban interface of developing countries, coordinating projects and programs on the safe recovery of water, nutrients and organic matter from domestic waste streams, with a special interest in safe wastewater irrigation, urban and peri-urban agriculture, and the cutting edge of applied inter-disciplinary research. Pay supervised a large number of graduate and postgraduate student, served on a range of different technical and scientific advisory committees, contributed to successful proposal of over US\$ 50m, and leads currently a program with an annual budget of US\$ 5m. He has edited several books and authored or co-authored over 300 publications, half in peer-reviewed journals. In 2015, Pay received the Development Award for Research of the International Water Association. He is based in Colombo, Sri Lanka, and has worked extensively in West and East Africa and South Asia.



## **Nighisty Ghezze**

INTERNATIONAL FOUNDATION FOR SCIENCE (IFS), SWEDEN

Nighisty is the Director of the International Foundation for Science (IFS), Stockholm. Formerly she was the Head of Programmes at IFS and has held responsibilities for coordinating the IFS research programme, developed strategy and policy, oversight of research areas, coordinating and evaluating supporting activities provided to the IFS constituency, as well as supervising programme staff. Nighisty has excellent knowledge of and contacts with researchers, research institutions, policy makers, and the development communities in Africa, the Middle East, and the Mediterranean. Dr Ghezze has a Bachelor degree in Economics, Master in the Legal and Institutional Management of Water Resources, a PhD in Natural Resources Management and another PhD in International Economics. She has more than thirty years of professional experience as a lecturer, researcher, senior network officer, training organizer, program and project leader and evaluator. She worked as a development consultant (2004-2007) with the UNDP, UNESCO, Sida, DGIS, IDRC, AfDB, Euro Consult, Danida and the EU. As Project Manager with the Global Water Partnership (1998-2004), she managed several integrated water resources management projects and led the work programme of four regional offices in Africa and two in the Mediterranean region, as well as coordinating the EU Water Initiative in Africa.



## **Thomas S Jayne**

MICHIGAN STATE UNIVERSITY (MSU), USA

Thomas Jayne is University Foundation Professor of Agricultural, Food, and Resource Economics at Michigan State University and Co-Director of the Alliance for African Partnership, a university-wide initiative to promote long-term collaborations with African research and policy organizations. Jayne is a Distinguished Fellow of the African Association of Agricultural Economists, and the chair-elect of the Agricultural and Applied Economics Association's Africa section. He has mentored dozens of young African professionals and played a major role in building MSU's partnerships with African agricultural policy research institutes. In 2017, he became the Flagship Co-Leader of the CGIAR Policies, Institutions and Markets research program on Economy-wide Factors Affecting Agricultural Growth and Rural Transformation. Over the past decade, he has received six research excellence awards, including the 2009 Outstanding Article Award in Agricultural Economics and the 2017 AAEA Bruce Gardner Memorial Prize for Applied Policy Analysis.



## **Dave Little**

UNIVERSITY OF STIRLING, UNITED KINGDOM

Dr Dave Little is Professor of Aquatic Resources and Development and leads the Aquaculture Systems Research Group within the Institute of Aquaculture, at the University of Stirling, UK. He is a specialist in aquatic food security and capacity building with a track record in research and outreach with commercial and development partners. He has over thirty years of experience in interdisciplinary research and education, a significant proportion based in the Region generating around £ 10 million income. He has published over 150 academic papers and reviews; (h index 36; >4000 citations). He has supervised over 100 postgraduate student research projects, of which more than 20 have been PhD. He has been both a coordinator and partner of interdisciplinary and intercultural research for development and continues these roles in various research and support actions.



## Luc Mougeot

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE (IDRC), CANADA

Luc J.A. Mougeot is a senior program specialist with the Technology and Innovation Division of Canada's International Development Research Centre (IDRC), Ottawa. At IDRC he headed its Urban Environment Management and its Cities Feeding People (CFP) programs, during which time CFP supported nearly one hundred research projects in Africa, the Middle East, Asia, and Latin America; a global research network; a graduate research awards program; a working paper series, plus regional courses for city teams. Luc has authored/edited over sixty publications, including *Growing Better Cities: Urban Agriculture for Sustainable Development* (2006) and *AGROPOLIS: The Social, Environmental, and Political Dimensions of Urban Agriculture* (2005). He is a contributor to *Food and the City; Histories of Culture and Cultivation* (ed. Dorothee Imbert ed., Harvard University Press, 2015) and *Integrated Urban Agriculture* (ed. Robert France, Green Frigate Books, 2016). Luc holds a doctorate in geography from Michigan State University, worked 12 years as faculty of Brazil's Federal University of Pará, and was post-doctoral fellow at British and German institutes. Luc serves on advisory, steering and peer-review committees on urban agriculture, joining the Board of Trustees of the RUA Foundation (global partnership on sustainable urban agriculture and food systems) in 2014.



## Bimbika Sijapati Basnett

CENTER FOR INTERNATIONAL FORESTRY RESEARCH (CIFOR), INDONESIA

Bimbika Sijapati Basnett is a Social Scientist and Gender Coordinator at the Center for International Forestry Research, one of the 15 centers of the CGIAR. Bimbika is based in CIFOR headquarters in Indonesia. She coordinates CIFOR's research on gender issues, and supports with the integration of gender research within the CGIAR's Research Program on Forests, Trees and Agroforests. Bimbika also manages and contributes to CIFOR's research on agribusiness investments in forested landscapes as well as on migration and mobility. Bimbika holds a PhD in Development Studies from the London School of Economics and Political Science. Prior to joining CIFOR, Bimbika worked as a researcher and consultant for various government and non-governmental organizations in the UK, Nepal and the South Pacific.



## Ingrid Öborn

ICRAF AND SLU, SWEDEN

Ingrid Öborn is the Southeast Asia Regional Coordinator of the World Agroforestry Centre (ICRAF) based in Bogor, Indonesia. Prior to moving to Indonesia late 2015 she was a Senior Research Fellow of ICRAF in Nairobi, Kenya, since 2012. Ingrid holds a Faculty Professorship in Agricultural Cropping System at the Swedish University of Agricultural Sciences (SLU) in Uppsala, Sweden, and while working for ICRAF she keeps a part-time engagement with SLU supervising post graduate students. Previously Ingrid was the Director of the Future Agriculture Program at SLU. She is also a visiting Professor of the Scotland's Rural Collage (SRUC) in Edinburgh, UK. Ingrid has a PhD in Soil Science and a Masters in Agricultural Science from SLU. Her research is focusing on smallholder farming, agroforestry, food and nutrition security and livelihood improvement at farm and landscape level, including sustainable natural resources management and bioenergy. Present research includes (i) Assessing the multi-functionality and resilience of agriculture with trees (agroforestry); productivity, soil fertility, climate change adaptation and mitigation, (ii) Biogeochemistry of agro-ecosystems including agronomic, environmental and food-chain aspects of nutrient and trace element cycling, and (iii) Foresight and future studies and methodologies related to food security, agricultural systems and natural resources management.

# SHORT BIOS OF CONFERENCE MODERATORS



## **Annika Åhnberg**

MODERATOR ON THE FIRST DAY

Annika Åhnberg is a former minister of agriculture and has been a member of the parliament in Sweden. She has for more than ten years been a consultant within the area of agriculture and food production in relation to sustainability. She is an experienced project leader and facilitator. Prior to being a consultant she was vice president at DeLaval Holding and heading its division for Public Affairs. She has been the chairperson of Save the Children Sweden. She has a bachelor degree of social work. She is now the chairperson of the steering committee of SIANI, Swedish International Agricultural Network Initiative and she is also the chairperson of the board of f3 (“fossil free fuels” is a networking cooperation between universities, research institutes and industry companies). Mrs Åhnberg is the chairperson of SNF, Swedish Nutrition Foundation. She is a member of the steering group of Axfoundation. She is member of the board of the International Institute for Industrial Environmental Economics – IIIIEE- at Lund University. She is a fellow of the Royal Swedish Academy of agriculture and forestry and of The Royal Swedish Academy of Engineering Sciences (IVA) and of the Royal Physiographic Society of Lund. Mrs Åhnberg is a honorary doctor at the Swedish University of Agricultural Sciences

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## **Marika Griehsel**

MODERATOR SECOND DAY

Marika Griehsel is a documentary filmmaker and an award winning senior foreign Correspondent having worked for Swedish Public Broadcasting, SVT. She was based in South Africa, Johannesburg during the 1990 covering the release of Nelson Mandela and the democratic transition and major news events on the continent. Today she is based in Sweden but travels regular to many parts of Africa. In her most recent film she follows the life of three families over several years as they have been forced to flee their home countries due to conflict and poverty. They now live in Kakuma refugee camp in northern Kenya.

Currently she is directing the film about Johan Gustavsson, the Swedish traveller that was kept hostage in the Desert in Mali for almost six years. The Swedish development agency Sida, Folke Bernadotte Academy and the Swedish Foreign Department among others do engage Marika as a moderator.

# POSTER SESSION DAY 1

## LECTURE ROOM: AULA

1. Crop production intensification technologies on smallholder farms – what are the contributions to productivity increase in relation to labour demand?
2. Insects and Health: exploring the potentials and challenges of *Macrotermes Bellicosus* (winged termites) as nutritional and dietary supplement for malnourished children in Gulu Municipality, northern Uganda
3. Insect frass biofertilisers: a novel soil amendment for resource-poor peri-urban farmers
4. Legume tree foliage potential use as feed for livestock in smallholder farms in Rwanda
5. Survey of smallholder beef cattle production systems in different agro-ecological zones of Cambodia
6. Description of production and management system for Bolivian Creole cattle-Studies needed to establish impact of rural-urban migration on conservation
7. Evaluating the potential of productive sanitation in Bolo Silasie village in Ethiopia
8. Introducing biochar-producing gasifier cook stoves in a rural community
9. Climate Change, food security and low employment: engaging youth in agriculture through YPARD
10. Water, land, food security and nutrition: A study of mothers with children (under 15) in Ethiopia
11. One region, many views: transformations and preferences in rural contexts
12. Agroforestry Network – evidence based research meeting practitioners for policy dialogue
13. Research for agriculture for development in a global food world - building capacity abroad and building capacity in Sweden

\* = presenter

The abstracts (13) are listed in order of suggested order during poster session.

# Crop production intensification technologies on smallholder farms – what are the contributions to productivity increase in relation to labour demand?

Sigrun Dahlin\*<sup>1</sup> and Leonard Rusinamhodzi<sup>2</sup>

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Labour is often the major input in low-input agriculture and its availability critical for timely operations. Proposed technologies for sustainable intensification of crop production are frequently labour demanding but labour availability on farms often constrained. Short-term returns to labour are therefore critical.

The main objective was to assess crop productivity increase due to technologies for soil fertility, water and weed management in relation to their labour demand on smallholder farms in sub-Saharan Africa (SSA). Specifically we sought to 1) assess the labour demand for selected technologies; 2) assess yield increase relative to labour cost above the most commonly used (baseline) technology for areas with high, medium and low opportunity cost of farm labour and for different agro-ecological conditions; and 3) discuss whether the suggested technologies give the farmers a net benefit large enough to warrant the risk of the investment.

We retrieved a total of 33 publications from trials under rain-fed conditions established in semi-arid and sub-humid environments in SSA containing data on both labour inputs and crop economic yields as well as sufficient metadata. Data were analysed using the metaphor package in R-Studio. The response ratio was chosen as an indicator of the effect size, and was calculated for each observation as the natural log of the response ratio.

Relations between the yield response and labour input revealed four situations defined by the degree of efficiency in terms of yield and/or labour: (a) increased yield and labour efficiency; (b) increased yield but low labour efficiency; (c) decreased yield but high labour efficiency; (d) decreased yield and low labour efficiency. These situations require targeted interventions. Situation (a) requires maintenance, (b) requires investments in machinery to reduce labour input, (c) requires investments in improved inputs, and (d) requires both improved inputs and machinery to increase yield and reduce labour input.

# Insects and Health: exploring the potentials and challenges of *Macrotermes Bellicosus* (winged termites) as nutritional and dietary supplement for malnourished children in Gulu Municipality, northern Uganda

Beatrice Odongkara\*<sup>1</sup> and Opira Otto<sup>2</sup>

<sup>1</sup> GULU UNIVERSITY, UGANDA

<sup>2</sup> SLU-UPPSALA, SWEDEN/APOPO TRUST – GULU, UGANDA

*Macrotermes Bellicosus* (winged termites) is highly nutritious with high fat, protein and mineral contents, thus representing a noteworthy source of food that could add key nutrients to the diets of many vulnerable people in urban and peri-urban Uganda. The paper explores the potentials and challenges of *Macrotermes Bellicosus* as nutritional and dietary supplement for malnourished and undernourished children in Gulu Municipality. We contend that by looking at consumer perceptions in a culture that considers *Macrotermes Bellicosus* (locally known as *ngwen*) a delicacy and eaten by the majority of people, it is possible to provide insights into the cultural mechanisms that underpin consumers acceptance of the insect. Potentials and challenges along winged termites' production chain are discussed based on published data, focus group discussions and key informant interviews in three peri-urban zones of Gulu Municipality. The results show that women dominate the supply chain, *ngwen* is a delicacy that is farmed and used as dietary supplement for malnourished or undernourished children. The paper therefore provides insights into the possibilities, challenges and acceptance of *Macrotermes Bellicosus* as nutrition and diet supplement. It also identifies the major issues to consider when promoting *ngwen* as supplementary diet for children.

# Insect frass biofertilisers: a novel soil amendment for resource-poor peri-urban farmers

Richard Quilliam\*<sup>1</sup>, Charles Nuku Adeku<sup>2</sup>, Pierre-Olivier Maquart<sup>3</sup>, Richard Newton<sup>3</sup> and Francis Murray<sup>3</sup>

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Insects possess great potential to efficiently convert organic matter into a high value source of protein and fat. Therefore, using organic waste to produce insect larvae for poultry and fish feed has the potential to provide sustainable solutions for both waste management and food security. Critically, the by-product from insect larvae production (insect frass and spent biomass) can be used as biofertiliser, which can increase soil organic matter and over time slowly release nutrients back into the soil. African cities produce significant quantities of organic wastes, e.g. market green wastes, poultry manure, and brewery wastes, and there already exists a strong social acceptance, based on cultural history, of using maggots as feed for poultry and aquaculture. Agronomy in West Africa, particularly as practiced by peri-urban smallholders, is frequently nutrient-limited despite the existence of localised organic waste streams. We aimed to support an adaptive-transition from a rural tradition of extensive low-input/output insect-based waste-remediation at the homestead level to an intensive peri-urban monoculture of high-yielding black soldier fly (BSF; *Hermetia illucens*) larvae and associated frass biofertilisers. Field-scale on-station agronomy growth trials with BSF frass biofertilisers were evaluated with a range of locally important short-cycle cash crops (especially shallots, peppers and maize). The results demonstrated BSF biofertilisers (at 10t/ha) combined with inorganic fertiliser applications produced up to 55% superior yield outcomes compared to the same inorganic fertiliser and local (poultry) manure combinations. Importantly, our research has also demonstrated that there is a burgeoning entrepreneurial market in Africa for commercialising insect larvae production. This 'circular economy' approach has greatest economic justification in peri-urban settings where there is co-location of input supply and the demand for co-products, which given the surge in peri-urban populations in West Africa and the associated increase in organic waste disposal challenges makes this production system extremely timely.

# Legume tree foliage potential use as feed for livestock in smallholder farms in Rwanda

Marguerite Mukangango\*<sup>1</sup>, Ewa Wredle<sup>2</sup>, Mupenzi Mutimura<sup>3</sup> and Sigrun Dahlin<sup>4</sup>

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Three legume tree species, *Acacia angustissima*, *Mimosa scabrella* and *Leucena pallida* and the grass *Cloris gayana* were grown on Ferral soils in Southern province of Rwanda. The legume species mixed with *C. gayana* at 30% legume or not were analyzed for crude protein (CP), crude fiber (CF), cellulose, neutral and acid detergent fibre (NDF and ADF), total phenolic and macro minerals. Gas production was measured by incubating samples in buffered rumen fluid from cannulated steer for 96 h. Cumulative gas, kinetics of gas production, organic matter digestibility and metabolizable energy were estimated.

Legumes had higher CP concentration (178 - 276 g kg<sup>-1</sup>DM) and a low value was recorded in *C. gayana* (44g kg<sup>-1</sup>DM). *C. gayana* grass had higher CF, NDF and ADF concentrations compared to legumes. The resulted ration from tree legumes mixed with grass basal diet improved the chemical nutritive value of the feed, organic matter digestibility and metabolizable energy which lead to production of higher microbial protein by the rumen microbes and an increase in feed utilization.

Supplementing feed animals with legume trees will provide balanced diet for animal and thus increase animal production. Legume trees constitute a sustainable source of animal feeds supplements for low income smallholders farmers but this depend on their capacity of biomass production, response to management as well as adaption to the high weathered soils.

# Survey of smallholder beef cattle production systems in different agro-ecological zones of Cambodia

Pok Samkol<sup>\*1</sup>, Keo Sath<sup>2</sup>, Mikaela Patel<sup>3</sup>, Peter Andrew Windsor<sup>4</sup> and Kjell Holtenius<sup>3</sup>

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<sup>4</sup> FACULTY OF VETERINARY SCIENCE, UNIVERSITY OF SYDNEY, CAMDEN, NSW 2570, AUSTRALIA

A survey was conducted to better understand the contribution of farm productivity to rural household income, and to identify differences in production systems, feeding practices, and development constraints of smallholder beef cattle producers in four agro-ecological zones (AEZs) of Cambodia. A detailed questionnaire was used standardize interviews of 360 households in four AEZs: I, Great Lake Floodplain; II, Mekong Floodplain; III, Coastal; and IV, Plateau/Mountainous. In addition, samples of common nutritional resources used for cattle feed were collected for nutrient composition analysis, plus cattle were scored for body condition. The results revealed that rice farming and cattle production were the most common sources of income in all AEZs. The average cattle herd size was 3.7 (SD=2.4), but the majority of households raised 1-3 animals. The most common cattle management system was grazing with supplementation, mainly with rice straw and 'cut-and-carry' natural grasses fed during the wet season in all AEZs. The mean body condition score during the wet season of all cattle types was 3.2 (SD=0.8), except for lactating cows that were 1.8 (four point scale). The major constraints to cattle production in AEZ I, II and III were lack of quality feed resources (mainly during the dry season), capital for cattle production and concerns on breed quality, whereas in AEZ IV, diseases were identified as the main constraint. Education of farmers to improve husbandry skills, increase utilization of forages and crop residues and address disease issues were found to be necessary to enhance cattle production.

## Description of production and management system for Bolivian Creole cattle-Studies needed to establish impact of rural-urban migration on conservation

Gabriela Bottani Claros<sup>\*1</sup>, Elisabeth Jonas<sup>2</sup> and Erling Strandberg<sup>2</sup>

<sup>1</sup> UNIVERSIDAD MAYOR DE SAN SIMÓN, CENTRO DE BIOTECNOLOGÍA Y NANOTECNOLOGÍA AGROPECUARIA Y FORESTAL, COCHABAMBA, BOLIVIA

<sup>2</sup> SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES, DEPARTMENT OF ANIMAL BREEDING AND GENETICS, UPPSALA, SWEDEN

Seventy percent of livestock producers in Pasorapa raise pure Creole cattle, while thirty percent have already introduced crossbred individuals and other exotic breeds. Crossbreeding and the use of exotic breeds aims to improve beef and milk production, but also creates a danger of extinction for the existing purebred native cattle populations. In most cases, farms consist of small herds, managed by the oldest members of families, while young people migrated to the big cities. Creole cattle herds remain grazing free in the forest for nine months per year, and only three months in the paddocks. During this time, vaccination and treatments against parasites are done. Lack of optimal farm infrastructure and animal behavior make these activities more difficult. This fact can explain the small sizes of most herds in Pasorapa, as well as the maintenance of the production and management systems. Because of its adaptation to survive in a xerophytic dry forest with long drought periods, consuming low quality food, showing still high fertility rates, Creole cattle population is recognized as the ideal breed to be raised under these conditions, contrary to other bovine breeds. Added to this, body conformation of animals would be result of a long adaptation process, important for movement in rugged terrains. Nevertheless, migration of younger people to the cities leads to risks for the future of cattle farming. This fact and results from this study, lead us to propose further studies to establish possible contributions of rural-urban migration process from Pasorapa, on conservation of Creole cattle populations, as well on conservation of native grass and other species in the forest.

# Evaluating the potential of productive sanitation in Bolo Silasie village in Ethiopia

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<sup>1</sup> STOCKHOLM RESILIENCE CENTER, STOCKHOLM, SWEDEN

Productive sanitation, also known as ecological sanitation, are sanitation systems which enable the safe recycling of nutrients to crop production in such a way that the use of non renewable resources is minimized. Human excreta (urine and faeces) are then considered resources that can be treated and reused in agricultural production. This research evaluated the potential of productive sanitation in a small holder agricultural context in Bolo Silasie village in Ethiopia, considering both the quantity of nutrients that could potentially be recycled and the fertilizer effect in field trials.

Based on samples from seven individuals, an annual quantity of 3.6 kg of N, 0.7 kg of P and 1.3 kg of K per person was estimated to be found in urine and faeces, corresponding to ~12 kg of chemical fertilizers per year, worth 140 Ethiopian Birr.

In a RCBD trial, urine and urea were used as two different top-dressers on wheat and showed a similar and significant effect on yield compared with only base fertilizer and the control. Urine addition resulted in ~18 kg of extra grain/kg N in urine or an extra ~50 kg of grain per person per year if complete urine recycling would be accomplished.

In participative trials 2014 and 2015, 15 and 22 farmers respectively compared the use of mainly local resources (½ dose compost + ½ dose DAP + ½ dose urine) with the conventional recommended fertilizer dose and a control. Again the results for the two treatments were similar and significant compared to the control.

In spite of promising results in the field trials, alternative ways to recycle urine are needed to enable wider uptake as the involved farmers rated urine collection (55%), transport (100%) and application (100%) as difficult. Adding urine in local compost production could be a viable alternative solution, needing further research.

## Introducing biochar-producing gasifier cook stoves in a rural community

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A top-lit updraft gasifier cookstove has more efficient combustion than an open three-stone fire. It thus has the potential to reduce smoke produced and firewood needed, which can have direct benefits on the health of women and children who spend much time in kitchens, and fuel collection. It can also have indirect benefits on the environment, by reducing air pollution and reducing the pressure on ecosystems from firewood collection. However, adoption rates of improved cookstoves are often low. Here we report results from a study that investigated factors that affect uptake of cookstoves. Gasifier cookstoves were issued to 50 households in Kwale County, a coastal region in Kenya. After training and 2-3 months of using the gasifier, the households were interviewed on the cookstove usage to find out the factors that might affect the uptake of the technology. Beneficial aspects identified by the users included use of less fuel and production of less smoke than in the three-stone fire. The gasifier was also easier to clean and adjust the heat. Moreover, the users appreciated production of biochar in the gasifier. More than 20% had used some of the biochar as a fuel, even though they had been asked to save it for later use in biochar field trials. Challenges with the gasifier included the need to prepare small pieces of wood to place in the cookstove, difficulty to light the stove, and difficulties in reloading the stove when cooking dishes that required long time to cook. More than 90 % of those who had received a gasifier were using it after 2-3 months, though with differing frequency of use, and they were all willing to continue using it. Biochar-producing gasifier cookstoves showed promising results in rural Kenya.

# Climate Change, food security and low employment: engaging youth in agriculture through YPARD

Sunil Abeyasekera\*<sup>1</sup>

<sup>1</sup> YOUNG PROFESSIONALS FOR AGRICULTURAL DEVELOPMENT (YPARD)

As the effects of climate change loom and continues to worsen, agricultural development and rural transformation is required to ensure both local and national food security. However, rural migration and an ageing farming population has left farms abandoned and untilled. The disillusionment of a traditional farming lifestyle has led the youth to move further afield, searching for urban employment. However, the rural exodus and urban influx creates a greater demand for produce, and reimagines the role of agriculture to address these issues. The use of technology, logistics and sales in agriculture is challenging the traditional methods, and addressing the shortfall in youth employment, through higher education and increased profits. YPARD, the Young Professionals for Agricultural Development, serves as a collective global platform enabling young professionals to realise their full potential and contribute towards innovative agricultural development. It creates spaces for deliberation and interaction, and encourages members to become active in their area, spread the news about YPARD to other young professionals, encourage a stronger voice of youth in their own organisations and share their views and ideas with other young professionals in the network.

# Water, land, food security and nutrition: A study of mothers with children (under 15) in Ethiopia

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<sup>1</sup> MCGILL INSTITUTE FOR GLOBAL FOOD SECURITY

Water is essential to food security and nutrition. Evidence has shown that African households without land have more restricted access to water. The main objective of this article was to investigate (1) mothers access to land; (2) to identify the association between watering frequency of land (exposure) and maternal/children's dietary diversity score (outcome) by controlling food security status (FIES) of mothers in Ethiopia (Afar, East and West Hararghe). Data on 2016 from Ethiopia (GROW) were used. Food Insecurity Experience Scale (FIES) was used to measure mothers' food security status. Different statistical analyses were carried out to identify the association between exposure and outcome variables. Results of logistic regression analyses showed that "no water on land/relying on raining" decreased maternal' dietary diversity score (OR=0.395) (P=0.001), and children's dietary diversity score (OR=0.385) (P=0.004). Maternal severe food insecurity decreased their dietary diversity score (OR=0.613) (P=0.053). Severe food insecure mothers also had children with low dietary diversity score (OR=0.450) (P=0.016). Further, significant differences were found between maternal and children's dietary diversity score with some controlling variables such as, maternal education, maternal working outside the home, saving money. So, availability of water on land affects maternal and their children's food security and nutrition status.

# One region, many views: transformations and preferences in rural contexts

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Located between two major metropolitan areas, São Paulo and Rio de Janeiro, the Paraíba Valley region plays an important role in the historical national scenery. Since the 19th century, this southeastern Brazilian region has passed through many socioeconomic and environmental changes. Considering these dynamic processes, the aim of this research was to investigate the transformations that people from rural areas of three municipalities (Caçapava, Santa Branca and Cunha) have observed in their social settings. General changes and land use changes on local and farm levels were questioned as well as the preferences on past and present land uses. Ninety semi-structured interviews were conducted from January to March 2016 as part of an ongoing doctoral study that aims to examine eucalyptus plantations and water resources relationship through the eyes of rural communities. Quantitative and qualitative analyses showed that observations on general changes varied from one municipality to another. Land use was the most noticed change at Caçapava and Santa Branca, while at Cunha population change was the most cited. In general, interviewees preferred past land uses on the local level and divided on farm level. Observations and preferences were interpreted under the social representation theory. The findings help understanding local dynamics through individual narratives and shed light on countryside transformations.

## Agroforestry Network – evidence based research meeting practitioners for policy dialogue

Linda Andersson\*<sup>1</sup>, Henrik Brundin\*<sup>1</sup>, Malin Gustafsson<sup>2</sup>, Madeleine Fogde<sup>3</sup>, Anders Malmer<sup>4</sup> and Johanna Björklund<sup>5</sup>

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Agroforestry Network is a Swedish network for international agroforestry practice, which brings together agroforestry experts, researchers and practitioners from different organisations and institutions. Vi-skogen founded Agroforestry Network to make agroforestry more known among development aid stakeholders and to share knowledge with other agroforestry experts. Today, the partners are Siani, Focali, Stockholm Resilience Centre, Agroforestry Sverige and SLU Global, and we welcome more partners.

More money for agroforestry in farming is well invested money. The natural resources sector needs to be prioritized and the focus of development cooperation should be to support the people living in poverty in rural areas. The purpose of Agroforestry Network is to be an arena for this, to communicate what the network partners do, and the results of our operations. We build on the experience of the partners – together we gain a greater weight to influence.

The network includes both an academic and a communicative component. It involves summits and knowledge gathering with the purpose of communicating agroforestry and sustainable agriculture. We release reports, policy briefs and articles together.

Recently, the network launched the database for scientific publications on agroforestry and the work of our partners. The platform presents key experts on agroforestry: [www.agroforestrynetwork.org](http://www.agroforestrynetwork.org)

The conference, with the aim to be a fora for both researchers and practitioners, fits the Agroforestry Network's ambitions perfectly. The network would through its participation hope to create new links between these sectors and discuss potential areas of collaboration in the area of agriculture and agroforestry.

# Research for agriculture for development in a global food world - building capacity abroad and building capacity in Sweden

Mats Lannerstad\*<sup>1</sup>, Johanna Lindahl<sup>2</sup> and Kristina Rowing de Nowina<sup>3</sup>

<sup>1</sup> INDEPENDENT CONSULTANT

<sup>2</sup> ILRI AND SLU

<sup>3</sup> CIFOR

Sweden has long been active on the scene of international research for development in agriculture and forestry. Sida and many Swedish research councils have supported both direct research activities as well as local research capacity development. One example is Sweden's continuous engagement in, and financial support of, the global agricultural research partnership CGIAR. Today, the CGIAR comprises 15 research centres. However, despite Sweden's large contribution, CGIAR remains largely unknown in Sweden, reflecting in low and uncoordinated collaboration with Swedish researchers and few Swedish scientists employed in the CGIAR.

In 2016, a SIANI supported expert-group for Swedish scientists working in several CGIAR institutes looked into the modalities of support for Swedish scientists to contribute to the field of international agricultural research for development, which resulted in a SAINI-report and a multi-stakeholder conference day at, and with, KSLA. The findings indicate that Minor Field Studies successfully introduces under-graduate students to developing countries, but that there are few opportunities to continue with PhD studies, and even less along a research career. In addition, most existing research is done out of Swedish institutes, with low collaboration with the CGIAR or other research institutes.

The expert group suggests more financial resources and opportunities for research on sustainable food production and an increased focus on ensuring a sustained Swedish resource base of experts in the topic, as well as further enabling mobility of scientists between institutes and countries, moving away from temporary investments towards more continuous programs where students and scientists can plan for a career.

This poster will, 1) present findings and ways forward to increase the Swedish capacity and presence on the international agricultural R4D arena, building on the expert-group study and the conference day at KSLA, 2) briefly present the CGIAR system, including links to and support from Sweden.

# SESSION 1 DAY 1

## LECTURE ROOM: K

### Land – under pressures or dynamic changes?

SESSION LEADERS: EWA WREDLE, SLU; MADELENE OSTWALD, GMV (CHALMERS/GU) AND LINKÖPING UNIVERSITY; INGRID ÖBORN, ICRAF AND SLU

### Session schedule

- 14.15-14.20 **Welcome and practicalities**  
*Ewa Wredle, SLU, Sweden and Madelene Ostwald, GMV (Chalmers/GU), Sweden*
- 14.20-14.40 **Landscape Restoration and Rural Transformation - Opportunities and Trade-offs.**  
*Keynote by Ingrid Öborn, ICRAF and SLU, Sweden*
- 14.40-14.55 **Developing land cover change methodology by combining remote sensing observations and pastoralist understandings.**  
*Patrick Wennström, SLU, Sweden*
- 14.55-15.10 **The Role of Pastoralists' Innovations in Managing Land Constraints and Climate Shocks in West Pokot, Kenya.**  
*Deborah Muricho, University of Nairobi, Kenya*
- 15.10-15.25 **Land deals in limbo – impacts of stalled large scale agro-investments in Tanzania.**  
*Linda Engström, SLU, Sweden*
- 15.30-15.45 Coffee break
- 15.50-16.05 **The modernization of agriculture through large-scale land acquisitions: the concretization of opportunities and threats to livelihoods in Mozambique.**  
*Juliana Porsani Jarkvist, Södertörn University, Sweden*
- 16.05-16.20 **Farmer perceptions on legumes in smallholder farming systems in east Africa.**  
*Tarirai Muoni, ILRI, Sweden*
- 16.20-16.45 **A perennial future? Solving agricultural challenges in sub-Saharan Africa through multifunctional perennial cropping systems.**  
*Elina Andersson, LU, Sweden*
- 16.45-17.15 **Concluding discussions and session reflections from**  
*Ingrid Öborn, ICRAF and SLU, Sweden*

# Developing land cover change methodology by combining remote sensing observations and pastoralist understandings

Patrick Wennström<sup>1</sup>

<sup>1</sup> DEPARTMENT OF URBAN AND RURAL DEVELOPMENT, SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES

Pastoralists in India are experiencing increased difficulties to sustain their livelihood, which is partly due to deterioration and diminishment of the pastoral lands that they depend on. Remote sensing is a powerful tool for investigating large-scale land cover change dynamics; however, a more complete and socially aware analysis of land cover change can be produced when incorporating qualitative data into the analysis. Through a case study in southern India, this study uses interviews, participatory mapping, and remote sensing to investigate how qualitative Geographic Information Systems (GIS) methodology could be developed by comparing quantitative and qualitative data in order to highlight differences and similarities between them. Remote sensing findings showed that open land, which is an important source of livestock feed, has decreased while agricultural land and built-up land have increased. This result corresponded quite well with the qualitative data although the pastoralists experienced the decrease in open land to be more extensive than remote sensing results indicated. The geographical locations where loss of pastures had occurred according to the pastoralists did not correspond with the remote sensing analysis possibly since the respondents referred to small but significant areas of change which were not observable on satellite imagery. This result illustrates the partiality of both methodologies and of knowledge in general and also points to the value of mixing methods within land cover research, a field which usually has a strong preference for exclusively quantitative methods.

# The Role of Pastoralists' Innovations in Managing Land Constraints and Climate Shocks in West Pokot, Kenya

Deborah Muricho<sup>1</sup>

DAVID JAKINDA OTIENO<sup>1</sup> AND WILLIS OLUOCH-KOSURA<sup>1</sup>

<sup>1</sup> DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY OF NAIROBI, KENYA

Pastoral production systems in Sub-Saharan Africa are characterized by recurrent shocks that result to losses of livestock and livelihood options. This, coupled with increasing population puts extreme pressure on land resources thereby undermining the prospect of welfare improvement. While this scenario points a bleak picture on pastoralists' survival, it offers an opportunity for innovation. Indeed, recent literature shows that pastoralists are beginning to adapt through various innovative land management approaches. However, the scope and contribution of these innovative land management methods is not known. The current study assessed the level of participation in and contribution of afforestation, land terracing, enclosures, fodder growing and pasture conservation, post harvest use of fields for grazing and, crop and livestock diversification practices on households' revenue. The results from focus group discussion, key informants consultations and individual household interviews showed that land tenure security augmented with extension training positively influence the application of these innovative land practices. Households practicing innovative methods reported higher mean annual revenues of USD 1800 compared USD 758 for non-adopters. The results also show that the use of innovative practices increases periods of food self-sufficiency considerably. These practices vary in intensity of their use in different regions but have the potential for enhancing food security and income and thus the need to have them espoused for sustainable pastoralism.

**Keywords:** Pastoralists' innovations, land management, West Pokot.

# Land deals in limbo – impacts of stalled large scale agro-investments in Tanzania

Linda Engström

SLU, UPPSALA

Over the past decade, a new wave of large scale agricultural investments swept over Africa as a response to multiple global crises of food and energy, climate change as well as financial instability. The global debate around these 'land grabs' has been heated. However, a closer scrutiny reveals that many of these schemes remain stalled or have failed completely. Indeed, in Tanzania, a majority of the planned investments never materialized. All biofuel investments have gone bankrupt or switched to food schemes with limited success in becoming operational. Yet, the academic debate has mainly focused on impacts from materialized investments and the drivers behind them. The author argues that, instead of treating stalled or failed large scale agricultural investments as if 'nothing happens', we need to pay more attention to what these investments do. This presentation examines so far under-researched dimensions of local land transactions around stalled and failed investment sites, and shows that land deals in limbo create space for a range of land re-arrangements. The presentation therefore concludes that the impacts of something that never happened indeed can be severe and will require more attention in academia as well as in policy debates.

# The modernization of agriculture through large-scale land acquisitions: the concretization of opportunities and threats to livelihoods in Mozambique

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As large-scale land acquisitions (LSLAs) gained pronounced attention after the latest food and financial crises, they also become important object of analysis of an exponential scientific literature production. Although discussions about the scale, drivers, actors, and opportunities and threats entailed by LSLAs are rife in recent literature, case-studies are meagre. As a consequence, we do know that land investments entail a multitude of opportunities and risks to livelihoods – related to the creation of jobs, the construction of infrastructure, and the dissemination of new technology, but also to land scarcity and consequential conflict over land access for productive and reproductive livelihood activities. However, we still have very limited knowledge on how these positive and negative potentialities are being concretized on different contexts.

Our study analyses a case in Mozambique, one of the countries most targeted by recent LSLAs and a country in which smallholder farming is a source of livelihood for approximately 70 percent of the total population. Based on 213 interviews with smallholders, we scrutinize the process and local implications of land loss driven by the acquisition of 20,000 hectares by a Chinese company operating in the Limpopo Valley. Our analysis show that land loss was not accompanied by effective community consultation, and that envisioned benefits such as job creation and membership in an out-grower scheme tended to benefit the already better-off households. For the rest of the impacted smallholders, the prospect of livelihood improvement will depend on the accessibility of these new opportunities and on their appropriateness to different groups that face different productive and reproductive constraints. Our findings stress the importance of investigating local

livelihood diversity, particularly with regards to gender, when considering the implications of this and of similar projects in areas where land access is largely determined by patriarchal land tenure systems.

# Farmer perceptions on legumes in smallholder farming systems in east Africa

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Legume types (grain, herbaceous and tree legumes) play an important role in smallholder farming systems in sub-Saharan Africa through provision of food, feed, income, soil erosion control, fuel and soil fertility. However, there is still potential to increase the productivity and the integration of multi-purpose legumes in smallholder farming systems. Better integration of legumes is a promising means of improving livelihoods and the sustainability of family farms. The objective of this study was to understand farmer attitudes towards legumes and their rationale for current legume production practices. A total of 265 farmers were interviewed in Democratic Republic of Congo (DRC) and Kenya. The results indicate that 40% of interviewed farmers could not clearly define what legumes are. Furthermore, 30% could give only a weak definition of legumes (name one legume or one characteristic of legumes). The most frequently mentioned legume functions were provision of food, feed and income, while a small number were able to identify other functions such as soil fertility improvement and soil erosion control. Farmers in DRC rated food as the most important benefit from legumes while farmers in Kenya ranked food and income as their priority legume functions. The majority of the farmers in both countries rely on radio as their source of legume-related information. We contend that if farmers had better knowledge about legumes and their functions then their integration in the cropping system would increase enhancing the sustainability of smallholder farms. Building legume knowledge among smallholder farmers in east Africa has potential to improve the smallholder farmers' food and nutrition security status, income and environmental stewardship.

## A perennial future? Solving agricultural challenges in sub-Saharan Africa through multifunctional perennial cropping systems

Wim Carton<sup>1</sup>

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LENNART OLSSON, LUND UNIVERSITY, LUCSUS, LUND, SWEDEN

ELINA ANDERSSON, LUND UNIVERSITY, LUCSUS, LUND, SWEDEN

A transition from the cultivation of annual crops in monocultures to perennial crops grown in polycultures could be a multifunctional solution to the coupled social-ecological challenges facing current food production systems. Perennial crops hold a number of promises that could be particularly beneficial in an African smallholder setting, including a dramatically reduced need for tilling, increased soil organic matter, reduced dependence on external inputs, decreased vulnerability to drought, and improved soil and water conservation. We here present an ongoing research project that studies the potential of perennial cropping systems to increase the resilience of Ugandan smallholder farming systems. Building on the latest developments in perennial crop breeding – with a focus on sorghum, rice and pigeon peas – and on participatory research methods, our aim is to investigate the ostensible social and environmental benefits of perennial cropping systems in smallholder contexts, as well as the various barriers that might be encountered during implementation. With this paper we present a roadmap for interdisciplinary research on perennial agriculture and highlight the relevance of this emerging research agenda for discussions on climate change adaptation and mitigation in sub-Saharan African contexts.

## LECTURE ROOM: AULA

### **Forests for Food Security – in the light of Equal Rights and Sustainable Resource Management**

SESSION LEADERS: MALIN GUSTAFSSON, FOCALI/GMV; JENNY FRIMAN, GU.

#### **Session schedule**

- 14.15-14.20 **Intro/setting the stage**  
*Jenny Friman, GU, Sweden*
- 14.35-16.55 Presentations
- 14.35-14.50 **Large-scale land investment and Africa: are they only for food production?**  
*Olayinka Idowu Kareem, Phillips-Universitaet Marburg, Germany*
- 14.55-15.10 **What is the evidence that gender affects access to and use of forest assets for food security? A systematic map.**  
*Ngolia Kimanzu, Salvation Army Stockholm, Sweden*
- 15.15-15.30 **Constraints and description of the determinants of access to forests for NTFP harvest in Burkina Faso.**  
*Mamounata Belem, DEF/INERA/CNRST, Burkina Faso*
- 15.35-15.55 Coffee break
- 15.55-16.10 **How can socio economic factors affect households' ability to manage forest resources for their livelihood in Southern Burkina Faso?**  
*Pascaline Coulibaly-Lingani, INERA/CNRST, Burkina Faso*
- 16.15-16.30 **Challenging climate vulnerabilities through reforestation projects: reflections from rural Nicaragua.**  
*Noémi Gonda, SLU, Sweden*
- 16.35-16.50 **Sustaining livelihoods with farm trees and forests in upland Myanmar: A case study of income portfolios and land-based livelihoods in Chin State.**  
*Laura Knoch, Chalmers, Sweden*
- 17.00-17.15 **Closing remarks**  
*Henrik Brundin, Vi Agroforestry, Sweden*

# Large-Scale Land Investment and Africa: are they only for Food Production?

Olayinka Idowu Kareem<sup>1</sup>

<sup>1</sup> DEVELOPMENT AND COOPERATIVE ECONOMICS, UNIVERSITY OF MARBURG, MARBURG, GERMANY.

The economic potentials of countries in part depend on their natural resources endowment and productive utilization. Land remains invaluable natural resource that is precious to man, but it is non-renewable. The non-renewability of land and the scarcity of fertile, arable and productive land led to its increasing demand. A lot of people in developing countries, particularly in Africa, depend on land for their economic activities and/or livelihood. This is due to the fact that, it is from it that food is provided, shelters are constructed, infrastructures are laid and other valuable minerals are found. Recent economic events, particularly the commodity crisis of 2007-2008, have shown that there had been increasing demand for land in the global south, especially in Africa, which affected the availability of fertile and arable land. It is on this basis that this study investigates whether the motivation for the global land rush in Africa is mainly for food production purposes or otherwise. This study adopts a selection bias model with firms' heterogeneity using a negative binomial estimator to find that the acquisition of large-land is not solely for agricultural food production but also for forestry, conservation, renewable energy and tourism. The findings also indicate that the propensity to acquire land is determined by the availability of arable land, economic size of the investors' countries, institution capacity, governance and security and safety in the destination countries. However, at the intensive margin, economic size does not stimulate land investment, so also trade, population density, institutions and security of life and property. The availability of arable land, good governance and adequate precipitation are the land investment-enhancing factors.

# What is the evidence that gender affects access to and use of forest assets for food security? A systematic map

Ngolia Kimanzu<sup>1</sup>

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LINLEY CHIWONA- KARLTUN- SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES, UPPSALA, SWEDEN

In many parts of the world, the natural resource base, including forests forms a very significant part of their livelihood. One of the key variables that define access and control over forests is gender. Both women and men, within households and communities, manage and use forests and have different roles, opportunities, responsibilities, when doing so. The access and use of forests, especially for food security, may therefore lead to different outcomes for both women and men. Here we hypothesise that, when women have equal access to forests, there may be better food security outcomes for individual s and households that are depended on forests for their livelihoods. A detailed map is here presented detailing the thematic and geographic extent of the evidence base, where we also assess the quality of the evidence, in accordance with a published priori protocol.

# Constraints and description of the determinants of access to forests for NTFP harvest in Burkina Faso

Mamounata Belem<sup>1</sup>

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The forest resources, in particular non-timber forest products (NTFP) are important for poverty reduction and the achievement of food security in rural environment. However, fairness and access to the forest resources constitute important elements in the forest management. This study attempts to describe the constraints and the important factors that determine access of the NTFP in three forests with different management modes that are biosphere reserve, classified forest and community forest. The methodological approach has been based on an inquiry by questionnaire to 341 persons in 9 riparian villages of the three forests. The correlation between variables as distance, presence of the forest agent, age, products collected, residence statute; gender, forest statute and access to the forests for NTFP collection have been analyzed. The results indicate that the access to the NTFP is weakly related to the gender and legal statute of the forest but linked significantly to age. However, access is fairly associated to distance, presence of the forest agent, residence statute and to numbers of products collected inside forests.

For products harvesting, rural populations reach community forest more easily than the classified' one. Distance and presence of the forest agent constitute the main constraints for the access to the protected areas.

**Keywords:** Local population perception – Non timber forest products – Access to forest – Harvest – Forest management

## How can socio economic factors affect households' ability to manage forest resources for their livelihood in Southern Burkina Faso?

Pascaline Coulibaly-Lingani<sup>1</sup>

<sup>1</sup> INERA-BURKINA FASO, AÏCHA TAPSOBA (INERA)

In Burkina Faso, as in most of the developing countries, Non-Timber Forest Products (NTFPs) play an important role for especially rural populations. The study was designed with the objectives of assessing the contribution of NTFPs to rural peoples' livelihood. It also examined key socioeconomic factors that affect households' ability to manage forest resource for their livelihood. Key informants interview, focus group discussion and household-based questionnaire survey were used to collect data. The study revealed that rural households largely relied on NTFPs for their livelihood. From the logistic regression model, factors such as gender, market forces, the distance away from the main road and wealth condition affect households' ability to manage forest resources. The high dependence of the households on NTFPs for livelihood vindicates increased consideration by policy makers.

# Challenging climate vulnerabilities through reforestation projects: reflections from rural Nicaragua

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In Nicaragua, one of the most climate change affected countries in the world, adaptation interventions encourage farmers to implement agroforestry, and to avoid the use of agricultural practices such as slash and burn. These interventions are mainly targeted towards climate vulnerable small-scale poor farmers who are often pictured as culprits of deforestation and having practices that are 'maladapted' to changing environmental conditions.

In this paper, I focus on the deforestation practices implemented by the small-scale farmers who appear in the Nicaraguan climate change narrative as 'ignorant' and 'in need to be trained' on agroforestry and forest conservation. To this end, I analyze the interconnected and multidimensional drivers that lead farmers to cut or burn down trees in two Nicaraguan rural communities where I did field research in 2013 and 2014. In El Pijibay, a community in the humid territory of the former agrarian frontier, small-scale cattle ranchers aspire to move further and further in the remaining forested areas despite NGO efforts to settle them permanently by encouraging them to become cocoa producers. In El Nancite, located in the 'Dry-Corridor', farmers want to stay on their ancestral land even if it is not productive anymore. In both communities, current agro-ecological conditions and social inequalities are such that there is little room left for farmers to adapt to climate change. In their contexts, the way climate change adaptation projects support reforestation is insufficient because these reforestation efforts rarely challenge the particular vulnerabilities that drive deforestation.

My observations call for better problematizing the changes that are being adapted to when reforestation is encouraged by climate change adaptation projects. I claim that reforestation as an adaptation strategy should be seen as a space for socio-environmental transformations: only then could reforestation lead to transformative and empowering environmental and social changes.

# Sustaining livelihoods with farm trees and forests in upland Myanmar: A case study of income portfolios and land-based livelihoods in Chin State

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Complex interactions between social-ecological drivers of change spur transformations of landscapes and livelihoods in Asia's mountain environments. Migration and the extended reach of markets, infrastructure, and state authorities, increase flows of information, goods and capital to and from formerly remote areas. These resources could be leveraged to effect positive change in upland communities, yet marginalization still limits the opportunity space for rural livelihoods. One reason for this is that existing land-use practices, such as swidden farming and the management of forest and farm trees for food, fuel and fodder, are often overlooked or even actively discouraged, despite their contribution to household economies and food security, especially in fragile biophysical environments. This pattern is observable across SEA, not just in Myanmar, where sectoral paradigms and policies are in flux, and the country's opening induces substantial inflows of resources from international aid agents and private investors. In consequence, decision makers and extension agents in Myanmar currently lack the knowledge needed to adequately evaluate outcomes of land-sector reforms and design interventions that foster innovation upon existing land-use practices. To address this critical knowledge gap, we use household survey data from 95 rural households in northern Chin State, to analyse (i) the role of land-based livelihood activities vis-à-vis other income generation strategies; (ii) the quantitative contribution of forest and farm trees to households' income portfolios; and (iii) the relative importance of areas under different land-use designations and tenure regimes for income portfolios. Our analysis demonstrates that forest and farm tree products substantially contribute to rural livelihoods in our study area. We argue that these income sources, and customary claims to land from which products originate, should be recognized in efforts to sustain a diversity of ecosystem functions in Myanmar's swidden mosaic landscapes, and support rural households in meeting their immediate needs and longer-term objectives.

## LECTURE ROOM: N

### **Fish farming for food security, nutrition and poverty reduction**

SESSION LEADERS: ANDERS KIESSLING, SLU; ANNA NORMAN HALDÉN, SLU

#### **Session schedule**

- 14.15-14.20 **Welcome and opening.**  
*Moderator Anders Kiessling, SLU, Sweden*
- 14.20-15.30 **SESSION PART I:**  
**Presentation 1: Potential for enhanced aquaculture production in small water reservoirs.**  
*Geraldine Matolla, University of Eldoret, Kenya*
- Presentation 2: Determinants of utilisation of fish tank innovation among homestead fish farmers in Osun State.**  
*Idris Badiru, University of Ibadan, Nigeria*
- Presentation 3: Aquaponic activities to introduce Aquaculture to the West bank region of Palestine.**  
*Mutaz Qutob, AlQuds University, Palestinian Authority*
- Presentation 4: Brewer's yeast as replacer of fish meal in diets to Tilapia (*Oreochromis niloticus*), evaluated in either a clear water or a biofloc environment.**  
*Nguyen Huu Yen Nhi, SLU, Sweden*
- Presentation 5: Using smoke liquid to treat external parasites on striped catfish (*Pangasianodon hypophthalmus*).**  
*Trinh Thi Lan, An Giang University, Viet Nam*
- 15.30 – 15.45 **Coffee break**
- 15.45-17.00 **SESSION PART II:**  
**Presentation 6: Gender and rural entrepreneurship in Sub-Saharan Africa: identifying the frontier for aquaculture research.**  
*Linley Chiwona-Karlun, SLU, Sweden*
- Presentation 7: Assessing the contribution of fish farming to household food security in smallholder farming in communities of Masvingo, Zimbabwe.**  
*Takesure Tozooneyi, University of Zimbabwe, Zimbabwe*
- Presentation 8: Sustainable small-holder aquaculture management in the Lower Mekong Delta, Vietnam for further poverty alleviation and food security: A review.**  
*Chau Thi Da, An Giang University, Viet Nam*
- Presentation 9: Fish farming in Cambodia and Tanzania, is there a lesson to learn from Vietnam?**  
*Torbjörn Lundh, SLU, Sweden*
- 17.00-17.15 **Discussion and concluding remarks.**  
*Dave Little, University of Stirling, UK*

(Each presentation in the session is 10 min +3 min discussion)

# Potential for enhanced aquaculture production in small water reservoirs

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RABURU P O<sup>1</sup>, NYARANGO S O<sup>1</sup>, NGEIYWA M<sup>1</sup>

The aquaculture sector has continued to grow significantly and has been a driver in stimulating economic growth by creating business opportunities and jobs, and has alleviated food insecurity and poverty in many developing countries. Small water reservoirs have high potential for enhanced aquaculture production and are an important resource for small rural communities. They have been identified as an important means to address many national policy objectives including food security, poverty alleviation and economic development. Success of fish production in such reservoirs depends on a number of factors such as limnological characteristics that affect the recruitment and survival of fish, physical and biological aspects of the water bodies as well as socio-economic conditions of communities in the vicinity. Studies indicate that while seasonality and geographical location affect on some aspects of water quality, small reservoirs are suitable for fish production as they are rich in phytoplankton and macro-invertebrate communities which serve as food. Demographic characteristics such as gender, age and income were found to influence community perceptions on culture based fisheries in small water reservoirs within their vicinity. Challenges facing the communities living around small reservoirs include lack of capital, availability of quality seed and feeds, access to markets, high cost of inputs, floods and drought. However, the greatest challenge was lack of knowledge. For sustainability in culture-based fisheries development in small reservoirs, mitigation measures against habitat degradation and water quality deterioration combined with strong community support systems should be adopted.

# Determinants of utilisation of fish tank innovation among homestead fish farmers in Osun State

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THEOPHILUS AMURE<sup>1</sup>

Fish farming is a livelihood activity with great potentials for poverty reduction in sub-Saharan Africa. This potential is however constrained by inadequate space, high transportation costs and other related challenges in peri-urban and urban communities of Nigeria. Collapsible fish tank is a recent technology designed to surmount these identified problems. There is however no reliable data on the adoption of the technology as well as the predisposing factors to its adoption among homestead fish farmers whom the innovation was designed for. This study therefore attempts to ascertain the determinants of adoption of collapsible fish tanks among homestead fish farmers in Osun State of Nigeria.

Structured questionnaire will be used to elicit data on fish farmers' socioeconomic characteristics, awareness, perception of the fish tank characteristics, adoption scores and constraints to adoption of collapsible fish tanks from 150 randomly selected respondents from the three agricultural zones in the State. Percentages and frequency counts will be used to describe the data collected. Meanwhile, the relationship between the adoption scores and the independent variables will be determined using regression analysis at 5% significance level. The study will isolate the main determinants of adoption of collapsible fish tanks in the study area and proffer appropriate recommendations to relevant stakeholders to enhance the adoption of the technology.

**Keywords:** Collapsible fish tank, adoption scores, innovation characteristics, urban farming

# Aquaponic activities to introduce Aquaculture to the West bank region of Palestine

Mutaz Qutob<sup>1</sup>

Amer Kanan<sup>1</sup>, Nandita Singh<sup>2</sup>, Jan-Erik Gustafsson<sup>2</sup>, Lina Suleiman<sup>2</sup> and Fredrik Grondahl<sup>2,1</sup>

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Palestine is a region confronted with limited availability and accessibility of water resources which greatly limit agriculture and fisheries as livelihood options. Moreover, even the available water resources are not utilized to their optimum efficiency. A study was carried out with the aim of introducing aquaculture in Palestine by developing an environmentally sustainable, economically competitive system for the intensive culture of fish. The study assessed the potential use of Aquaponic systems for rearing tilapia *Oreochromis niloticus* and cultivating plants in closed recirculating systems, namely, lettuce, cucumber, cauliflower and common duckweed *Lemna minor*. The plants were used as natural biofilters in fresh closed recirculating systems to evaluate the possibility of fish and vegetation production. Four closed recirculating systems each having 50 mixed *Oreochromis niloticus* were used. Duckweed *L. minor* and fresh water were used in system 1. Lettuce and fresh water were planted in system 2. Cucumber and fresh water were planted in system 3. Cauliflower and fresh water were planted in system 4. Ammonium  $\text{NH}_4^+$  and nitrate  $\text{NO}_3^-$  were tested periodically in each system during a four month period. The growth of both fish and the plants were a direct function of temperature. Fish in the four systems have shown normal mortality and growth rate. Duckweed has shown very high biomass increase. The leaves of the cucumber and lettuce have shown symptoms of lack of certain micro-mineral. Cauliflower and cucumber plants were shorter than usual. The result of the experiment have shown that introducing Aquaculture to Palestine in a sustainable way is possible and promising. Further experiments are still under progress.

# Brewer's yeast as replacer of fish meal in diets to Tilapia (*Oreochromis niloticus*), evaluated in either a clear water or a biofloc environment

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Brewer's yeast as replacer of fish meal in diets to Tilapia (*Oreochromis niloticus*) was evaluated in either a clear water or a biofloc environment. Triplicate groups, each of 20 juvenile tilapia (initial weight of  $29 \pm 3.2\text{g}$ ), was randomly designated into 24 conical 500 l tanks equipped with feed waste traps. The system was divided between 12 tanks of clear water RAS with mechanical and biological filters and an average 15% daily replacement of water, and 12 tanks connected to four serial 10 m<sup>3</sup> open bio generator tanks. Bio generator tanks were initially fed with *Lactobacillus* and nutrients in order to achieve a C:N ratio of 10, in support of bacterial growth. In the biofloc system only evaporated water was replaced. Four iso-nitrogenous (35%) and iso-energetic (4500kcal/kg) diets were formulated to contain graded levels of brewer's yeast. Fish meal protein was replaced by 0%, 30%, 60%, and 100% of yeast. Fish was reared for three months and hand fed two times per day achieving at least a fivefold increase in weight. At the end of the experiment, feed intake, protein intake, weight gain, daily weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, survival rate, and body indices of tilapia were determined. Only in clear water reared fish was a significant reduction seen in weight gain, daily weight gain, and specific growth rate with replacement of fish meal, and then only in the 100% replacement group. If the two environments were compared, a significant higher growth was seen in fish kept in the biofloc environment parallel with a significant improved FCR, protein efficiency, and reduced mortality. This in spite a nearly identical feed and protein intake. Only in clear water was a significant decrease in entero-somatic and intestinal index seen with increasing levels of dietary Brewer's yeast. No significant effect or trends was noted in any other body indices data either with yeast inclusion or between water environments. Based on this we conclude that Brewer's yeast constitutes a possible high volume substitute for fish meal in Tilapia diets, especially if the fish are reared in a high density microbial environment, i.e. so called biofloc.

**Key words:** Nile tilapia, brewer's yeast, alternative protein, biofloc, clear water

# Using smoke liquid to treat external parasites on striped catfish (*Pangasianodon hypophthalmus*)

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Smoking is a traditional method of preserving fish products that kills potentially harmful spoilage organisms and also imparts desirable colour and flavor on the flesh. In recent years, liquid smoke has been used as faster and cheaper way of imparting desirable colour and flavor on the fish but little attention has been paid to any effects on spoilage organisms that may be present. Here we investigate liquid smoke as a treatment for parasitic organisms on live striped catfish (*Pangasianodon hypophthalmus*) by evaluating acute toxicity of smoke liquid to the fish and any effects on parasitic rotifer by immersion treatment. Acute toxicity of smoke liquid on striped catfish fingerlings was examined using randomized design over 96 h with 5 concentrations of smoke liquid and one control treatment. Treatments were repeated three times. Environmental factors such as pH and temperature were monitored daily. The result showed that LC50-96h of smoke liquid for striped catfish is 0.26%. The research using smoke liquid to treat external parasites on striped catfish was randomized with three treatment concentrations at 10% LC50-96h, 25% LC50-96h, 50% LC50-96h and one control treatment. All treatments had three replicates. Fish with parasites were immersed in the smoke liquid solution for 30 min, before being transferred to fresh water for recovery. Examination of external parasites on the gill and skin was performed 1 h, 24 h, 48 h and 72 h after smoke liquid immersion. After 72h, smoke liquid treatment was observed to reduce rotifers at all concentrations, (i.e. 10%, 25% and 50% LC50 - 96h), with 99.21%, 97.65% and 100% clearance of rotifers, respectively. There was no statistically significant difference between treatments ( $P > 0.05$ ). In addition, there was no re-infection after treatment. For flukes, smoke liquid gave the best treatment effect after one hour of immersion, resulting in 26.05%, 59.80% and 75.64% treatment effects respectively for treatment at 10%, 25% and 50% concentration of LC50-96h.

**Keywords:** acute toxicity, exogenous parasite, smoke liquid, striped catfish

# Gender and rural entrepreneurship in Sub-Saharan Africa: identifying the frontier for aquaculture research

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Globally women play an important role in the provisioning of food and particularly at the household level in resource poor settings. However, women do not always have the control of the resources, make the key decisions about food, food policy or food value chains. Research in agriculture, particularly in SSA, has often adopted a myopic view of a single actor (the male farmer) when a value chain approach is better suited to analyze the complexities of the agricultural sector. While linking farmers to markets through efficient and effective value chains has emerged as a key international development priority, women and their contributions in the agricultural food chains continue to be neglected. One such area that has hitherto been not well understood is aquaculture. Through a structured literature review and deep dive case studies in Tanzania and Nigeria this paper therefore analyse the perspectives on and roles for women in current aquaculture initiatives. Aquaculture is showing to be an engaging and profitable enterprise for many farmers in SSA. Not only can fish farming contribute to food security, increased household resilience and reduced vulnerability to natural hazards and economic uncertainty, it has also been shown to be complimentary to many farming practices. While aquaculture provides direct and indirect employment opportunities, in particular for women, there are needs for deeper understanding about opportunities and barriers to entry for women as well as at which stages in the value chain contributions result in the highest returns. The paper therefore also investigates the effects that current aquaculture initiatives have for rural development and women.

# Assessing the contribution of fish farming to household food security in smallholder farming in communities of Masvingo, Zimbabwe

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The study investigates the contribution of fish farming to household food security and income among smallholder farmers in Zimbabwe. Fish farming has emerged as an important livelihoods strategy for most communities in a country where estimates suggest that about 33 % of the population are undernourished, with about 11% of children under five years moderately or severely underweight (FAO, 2016). However, attempts to measure the impacts of fish farming on household food security and livelihoods have yielded mixed results, mostly due to lack of appropriate econometric techniques for accurately measuring impacts. Most studies have tended to use a simple 'with and without' approach where participants of fish farming ventures are compared to non-participants vis-à-vis welfare measures such as incomes and household food security. The biggest challenge in this approach, however, is the failure to capture self-selection bias and thus suffers endogeneity issues. As an innovation, and building on previous frameworks, we therefore propose applying a Treatment Effect Regression Model, to assess how fish farming impacts on household food security. The proposed study will also adopt and build on the Sustainable Livelihoods Framework approach in order to fully capture the contributions of fish farming on household food security and livelihoods of smallholder farmers. The model will be applied to 300 randomly selected households in Masvingo District of Zimbabwe. The district is strategically selected because of its susceptibility to dry spells and hence food insecurity. Fish farming is thus an important livelihoods and coping mechanism for a significant number of farming households in the district. The results will demonstrate the extent to which fish farming contributes to household food security and thus provide vital evidence that can be used by the government extension agents, non-governmental organizations, private sector players, as well as other important stakeholders in the fish farming value chain.

# **Sustainable small-holder aquaculture management in the Lower Mekong Delta, Vietnam for further poverty alleviation and food security: A review**

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World fish production from capture fisheries and aquaculture is very significant for global food security and food trade, providing an apparent per capita food fish supply of 18.8 kg (FAO, 2014). Fish is an excellent source of high quality animal protein, micronutrients and essential fatty acids which can reduce risk of coronary heart disease and stroke of people. It was already estimated and widely accepted that fish production will be needed to almost double to meet demand of 9 billion global people by 2050 (FAO, 2014). Vietnam is globally the fourth largest aquaculture producer and the most aquaculture practices in the Mekong Delta region traditionally are operated by small-scale poor farmers. Currently, scientists have already indicated that during the foreseeable future (20 and 30 years) both agriculture and aquaculture farming this region, including the fisheries sectors of the regional Lower Mekong Basin of Vietnam, would not have sustainable growth because of their exposure to the significant biophysical changes caused by the upstream basin activities development, water environmental pollution, over use feed wetland ecosystems degradation due to climate change impacts. The overall aim of the proposed activities is to analyse how future different small-scale Pangasius, Tilapia and freshwater shrimp farming systems could be developed and designed to maximize the benefits that society receives from aquaculture production for sustainable local livelihood's income, poverty reduction and food security in the future. It is expected to address and answer to some issues questions as following: what are the driving forces causing changes, opportunities and constraints in these aquaculture sectors? How important are these sectors for local peoples livelihoods and how vulnerable are these sectors to upstream development activities and climate change? Finally, we are also expected to provide a best recommendation to local policy makers and managers for the future sustainable small-scale aquaculture development.

## **Fish farming in Cambodia and Tanzania, is there a lesson to learn from Vietnam?**

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In Cambodia, fish is a central source of food for the rural poor with a per capita consumption over 30 kg. In the Lower Mekong Basin inland capture fish and other aquatic animals (OAA) contribute more than 50% of animal protein consumption (WorldFish Center, 2008). Expansion of hydropower in the Mekong basin constitute an apparent risk of affecting the main fisheries negatively. In Tanzania, on the other hand, fish consumption per capita is below 10 kg, and an increase in consumption could have very positive effects on nutrition status. Vietnam, also being a tropical country with similar natural conditions has grown into one of the top three aquaculture countries globally and have a per capita sea food consumption of over 40 kg. The question then arise if aquaculture also constitute a possibility for Cambodia and Tanzania, and is there a lesson to be learned from the Vietnam case?

## LECTURE ROOM: L

### **Knowledge Based Bioeconomies -Tools for Agricultural Transformation and Rural Development**

SESSION LEADERS: IVAR VIRGIN, SEI; ANTONY CHAPOTO, IAPRI

#### **Session schedule**

- 08:45-08:55 **Introduction and welcome.**  
*Ivar Virgin SEI, Sweden; Antony Chapoto, IAPRI, Zambia*
- 08:55-09:10 **A study on local people's perception of food waste management and recycling strategies for fish feed: a case study of An Giang province, Vietnam.**  
*Hiep Le Ngoc, An Giang University, Vietnam*
- 09:10-09:25 **Agro-industrial by-products as an alternative and sustainable animal feeds: insights from using grape pomace in dairy cow's diet.**  
*Ramy Elgendy, University of Padova, Legnaro, Italy*
- 09:25-09:40 **Brewer's yeast as protein source to Tilapia (*Oreochromis niloticus*) cultured in biofloc and clear water recirculation systems.**  
*Chau Thi Da, An Giang University, Vietnam*
- 09:40-09:55 **Overcoming barriers in the use of Interactive Voice Services to disseminate agricultural information to smallholder farmers in East Africa.**  
*Calvince Okello, Vi Agroforestry, Kenya*
- 09:55-10:10 **Biochar for long-term food security in smallholder farms in Kenya.**  
*Thomas Kätterer, SLU, Sweden*
- 10.10-10-25 **Studying biochar as a multilayer technology.**  
*Yahia Mahmoud, LU, Sweden*
- 10.25-10.45 **Coffee break**
- 10:45-11.00 **Role of mineral nanoparticles in improving attachment and colonization by plant growth promoting rhizobacteria.**  
*Salme Timmusk, SLU, Sweden*
- 11:00-11.15 **Providing decision support for improved soil fertility management in smallholder farming systems in East Africa.**  
*Kristin Piikki, SLU, Sweden, International Center for Tropical Agriculture (CIAT), Kenya*
- 11:15-12.00 **General discussion. Moderated by**  
*Ivar Virgin SEI, Sweden; Antony Chapoto, IAPRI, Zambia*

# A study on local people's perception of food waste management and recycling strategies for fish feed: a case study of An Giang province, Vietnam

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Food waste related issues in developing countries is currently considered to be a major threatening factor for Sustainable Development Goals. Aims of this study are to provide baseline of the generation rates, chemical composition of food waste and to evaluate local people's perception of food waste management and recycling. Finally, it is expected to recommend for strategy plan to manage and recycle food waste further using as fish feed. This descriptive-analytic and cross-sectional study was carried out in 2017. Food waste samples were collected everyday for one week from 10 restaurants, 10 small food stores and 10 household for chemical composition analysis. About 423 respondents were randomly selected to investigate their perception (knowledge, attitude and practice) on food waste management and recycling through scored-questionnaire survey. Results of study show that food waste composition mostly were meat and fish (around 35%), while rice and noodles accounted for 25%. The average amount of restaurants, small food stores and household food waste per week were  $190.27 \pm 158.17$ ,  $80.97 \pm 69.2$ ,  $4.67 \pm 3.95$  kg, respectively ( $P < 0.05$ ). The average nutrient content of food waste was approximately 21.70% CP, 19.25% Fat, 11.73% (Moisture), 2.75% (Fiber) and 0.06% (Ash). This study was indicated that the perception of local people on food waste management and recycling was fairly low, Pearson statistic between knowledge, attitude and practices in this study were significant correlation ( $p < 0.05$ ) with R (knowledge-attitude) = 0.195; R (knowledge-practice) = 0.113. As nutrient content of food waste is quite high, it is one of best option choice as potential protein for fish feed. From this research finding for future research, the available technologies as drying or black soldier fly bioconversion should be applied to convert food waste as a protein source for fish feed using to replace partly fish meal in fish diets in the future.

# Agro-industrial by-products as an alternative and sustainable animal feeds: insights from using grape pomace in dairy cow's diet

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Livestock is the world's largest user of land resources, with almost 80% of the total agricultural land being dedicated to animal feeds. Further, the global meat production has quadrupled over the past 50 years. This trend is predicted to continue, especially due to the growing urban middle classes in the emerging economies. To fill the predicted global animal protein supply-demand gap and potentially create a more sustainable animal feed, more innovative and alternative animal feeds are being proposed. That's why the inclusion of some agro-industrial by-products in animals' diet is becoming attractive not only for being part of an ambitious waste management and sustainability policies but also due to its possible nutritive values. In the present pilot study, we aimed at evaluating, from a zootechnical and nutrigenomics viewpoint, the effects of adding grape pomace (GP) - the polyphenol-rich by-product of the wine industry – to the diet of dairy cows. Twelve lactating Holstein-Friesian cows, homogeneous for age and lactation period, were assigned to two groups of six animals each. The first group received a basal diet and served as a control (CTR), while the other received a 10% GP-supplemented diet for 67 days. RNA sequencing-based analysis was performed on whole blood collected from each group at 2 time-points [beginning (T0), and after 67 days of the GP supplementation (Tf)]. Although the GP supplementation decreased the cost of the total feed, improved the cows' overall performance, weight gain, and milk production, the nutrigenomics analyses evidenced a significant repression of the ribosome biogenesis ( $P = 5 \times 10^{-55}$ ) and the oxidative phosphorylation ( $P < 0.005$ ) signaling pathways. These results indicate that the 'seemingly' sound phenotype was accompanied by a disrupted energy machinery and possibly stressed animals. Thus, extensive research should be carried on the alternative animal feeds before any large-scale implementation in livestock feeding.

# Brewer's yeast as protein source to Tilapia (*Oreochromis niloticus*) cultured in biofloc and clear water recirculation systems

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In this study, feeding trials were carried out to evaluate the potential of the replacement fishmeal with brewer's yeast in the diets of tilapia (*Oreochromis niloticus*) cultured in biofloc and clear water recirculation systems. Tilapia with an average initial weight of  $29 \pm 3.2\text{g}$  were randomly stocked in 24 culture tanks (500L per tank), 12 tanks clear water parallel with 12 tanks biofloc, at a stocking density of 20 fish per tank. Lactobacillus and molasses was added into the biofloc system to get a C:N ratio of 10. Four iso-nitrogenic (35%) and isocaloric (4500kcal/kg) diets were formulated. Fish meal protein was replaced by 0%, 30%, 60%, and 100% of brewer's yeast. Fish was rearing in 3 months and fed 2 time per days. At the end of the experiment, feed intake protein intake, weight gain, daily weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, survival rate, and body indices of tilapia were determined. The result of this experiment showed that the weight gain, daily weight gain, and specific growth rate was lowest in treatment replace 100% fish meal by spent brewer's yeast in the clear water system whilst there were no significant differences in other treatments had 0%, 30% and 60% brewer's yeast. In addition, tilapia in the biofloc system show a significantly better growth performance, feed utilization and survival rate than in clear water. However, the body indices data was not clearly showing diet effects. In conclusion, brewer's yeast could replace 60% of fish meal protein in diets for tilapia cultured in the clear water system. In the biofloc system could fishmeal be totally replaced by yeast without any effect on growth performance and feed utilization.

**Keywords:** Nile tilapia, brewer's yeast, alternative protein, biofloc, clear water

# Overcoming barriers in the use of Interactive Voice Services to disseminate agricultural information to small-holder farmers in East Africa

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The use of mobile phones to disseminate agricultural information to farmers in the rural areas is increasingly becoming very popular in Sub-Saharan Africa. With high rate of mobile phone penetration in the region, value added services are getting popular day by day. Using mobile phones as an important tool for communication among the smallholder farmers is being embraced by many development organizations in the region. However, the challenges of illiteracy and lack of a common language in the rural areas have made it very difficult to fully utilize various features of a mobile phone in disseminating information to the smallholder farmers. One important feature in the mobile phones that can be fully utilized to disseminate information with minimal challenges is the interactive voice service. Conversely, there are barriers to effective use of interactive voice services to convey vital information to the smallholder farmers. This paper examines the various barriers to effective communication among smallholder farmers in the rural parts of East Africa using interactive voice response and how to eventually overcome them. Therefore, to overcome these barriers, development organizations, governments and private enterprises who may want to use this service need to get right the time of delivery, acceptable length of the message, correct package of information and authentic source. If all these issues are well considered, interactive voice service becomes the most effective tool for communication among the smallholder farmers in rural parts of East Africa.

**Keywords:** Interactive Voice Service, Mobile Phones, Information, Dissemination

# Biochar for long-term food security in smallholder farms in Kenya

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Application of biochar has been shown to increase soil fertility and mitigate climate change through soil carbon sequestration. However, little is known about the sustainability of crop yield responses reported in the literature. Biochar usually contains ash, which provides plant nutrients and has a liming effect. It is therefore probable that yield responses decline with time. To investigate this, we laid out meta-replicated field experiments in 2006, and three are still running at three sites in Kenya. Maize and soybeans are grown in rotation in a randomized block design at all sites. During 20 growing seasons (10 years) the positive effect on crop yield has been persistent after application of 10 kg biochar m<sup>2</sup> during the first year of the experiment, both in treatments with and without mineral fertilization. In 2015, three new experiments were started in eastern, central and western Kenya for testing the effect of much lower amounts of biochar on crop performance under maize monoculture. Application rates of biochar in these experiments (0.1, 0.5 and 1.0 kg m<sup>2</sup>) were based on the amounts realistically produced from local resources available at smallholder farms. During the three (two in western Kenya) growing seasons after application, crop yield responses were highly consistent and did not decline with time. Crop yields were on average 2.9, 5.0 and 6.4 times higher, compared with the unfertilized control, after application of 0.1, 0.5 and 1.0 kg m<sup>2</sup> biochar, respectively. Corresponding relative yield increases in the NPK-fertilized treatments were about half as high. Surprisingly, the effect on crop yield of the lowest biochar dose was higher than the effect of mineral fertilizer application (7.5 g N m<sup>2</sup> season<sup>1</sup>). In conclusion, the yield enhancing effect of biochar is long-lasting at the studied sites. Biochar application can thus increase food security for smallholder farms in Kenya.

## Studying biochar as a multilayer technology

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The study of biochar and its different uses is gaining momentum all over the world. However, results deriving from diverse projects reveal numerous complexities ranging from physicochemical to socio-cultural ones. This makes biochar an emerging topic that is interesting but challenging to study. To assess its applicability as a means to tackle soil degradation, diminishing fuel sources and unhealthy cooking techniques in smallholder farming systems, we are carrying out a long-term (2013-2019) and multidisciplinary study that includes 152 households in three counties in Kenya. The overall aim of the project is (i) to characterize and quantify available organic residues (OR) for biochar production at farm level, with a focus on non-traditional ORs; (ii) to assess gasifier cook stoves for energy use efficiency and emissions compared to current cooking technologies; (iii) to evaluate how biochar affects soil health and crop productivity; and (iv) to study the socio-economic potentials that biochar might bring to different agro-ecosystems and social settings. The project is implemented by a team comprised of soil scientists, an environmental engineer, an environmental and bioenergy scientist and a social scientist working tightly together. We have been using a variety of approaches that range from discipline-specific to interdisciplinary ones, aiming to integrate natural and social science methods. As the final aim of the project is to make farmers acquainted with the uses of biochar and harness its production and application we have relied heavily on participatory methods. Since their emergence in the 1970s, these methodologies have enabled communities to own, shape and guide their own development projects. Despite its wide acceptance, participation is still understood and practiced in diverse ways and has pros and cons. This paper accounts for methodological challenges and solutions involved in studying such a complex topic as biochar from a multidisciplinary and participatory perspective.

# Role of mineral nanoparticles in improving attachment and colonization by plant growth promoting rhizobacteria

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The soil surrounding plant roots is one of the main sources of bacteria expressing plant-beneficial activities (PGPR). Recently we have shown that the PGPR have great potential in protecting plants against abiotic and biotic stress situations and

restoring marginal lands (1-3). The effectiveness of the inoculum is related to the formulation technology protecting the cells from the surrounding environment and elimination of secondary effects. Titania nanoparticle (TN) formulation form stable, large and thick bacterial clumps as a biofilm which influence plant growth via facilitating root hair length and density and improving mulch biofilm formation (1-3). This effect is especially pronounced in complex environments where several PGPR strains are used in combination with TNs (1). The biofilm substantially improves root soil contact and significantly enhances plant nutrient or biologically active compound acquisition from soil or bacterial origin. In addition, improved organic matter content and porosity restores marginal lands (1). Based on the studies we will create quantitative knowledge framework

interrelating biological systems responding to dynamic environment (4). This would ensure that the great potential of PGPR science would find its way to facilitating reproducible field application and sustainable food production under changing climate.

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# Providing decision support for improved soil fertility management in smallholder farming systems in East Africa

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\* PRESENTING AUTHOR

There is an ongoing four-year collaboration project between SLU and CIAT, aiming at developing methods to provide decision makers, extension officers and farmers with relevant soil information for improving soil fertility management in small-holder farming systems in East Africa.

- WP1 Proximal sensors for in situ soil property measurements. In a screening study of sensor technologies, it was found that a simple dual wavelength reflectance sensor and a handheld X-ray fluorescence sensor were both promising for in situ measurements of soil organic carbon (SOC) content and other soil properties.
- WP2 Downscaling large-scale soil data for local use. In a study in Rwanda it was found that the regression kriging with only 100 soil samples taken across the country was a viable method to adapt continental maps of SOC content and soil pH for use locally.
- WP3 Soil maps for the extension service. A geostatistical method is being developed to produce risk maps of low pH and nutrient deficiencies at village scale. The work is ongoing and is carried out in two villages in W. Kenya.
- WP4 Soil data for crop modelling. It was found that taking the constraining effect exerted by low SOC content in the topsoil into account improved the spatial modelling crop suitability. The EcoCrop algorithm was adapted and a public SOC map of Tanzania used as input when modelling the suitability of common beans (*Phaseolus vulgaris* L.).

The project is financed by Formas/SIDA (contract 220-2013-1975). Main collaborators are Embu University, Kenya, Nairobi University, Kenya, Crop Nutrition Laboratory Services Ltd, Kenya, World Agroforestry Center (ICRAF), Kenya and Veris Technologies, USA.

## LECTURE ROOM: K

### Water in Transforming Landscapes

SESSION LEADERS: LOTTA SAMUELSON, SIWI; KRISTINA JOHANSSON, SIWI; ANNA TENGBERG, SIWI; NIGHISTY GHEZAE, IFS

#### Session schedule

- 08.45-08.55 **Welcome.**  
*Anna Tengberg, SIWI, Sweden*
- 08.55-09.15 **Keynote presentation.**  
*Nighisty Ghezae, IFS, Sweden*
- 09.15-10:30 PRESENTATION OF CASE STUDIES  
**Case 1 – Assessing the scope for resilient crop yields through rainwater management under rainfall variability in sub-Saharan Africa.**  
*Mats Lannerstad, Sweden*
- Case 2 – Success and Challenging factors to enhancing rural community resilience to drought through Rainwater harvesting in Bugesera in Rwanda.**  
*Lazare Nzeyimana, Linköping University, Sweden*
- Case 3 – Smallholder farmer’s willingness to pay for improved irrigation water: Contingent valuation study in Mashonaland Central irrigation schemes, Zimbabwe.**  
*Innocent Vomitadyo, Univeristy of Zimbabwe, Zimbabwe*
- Case 4 – A new technology for optimizing plant available water and nutrients in root zones of permeable soils.**  
*Alvin Smucker, Michigan State University, USA*
- 10.30-11.00 **Coffee break**
- 11.00-11.20 PRESENTATION OF CASE STUDIES  
**Case 5 – Sustainable Energy Generation through Wastewater: A situation in the Urban City of Lagos, Nigeria.**  
*Buraimoh Oluwatosin Gabriel, Ogun State Institute of Technology, Nigeria*
- 11.20-11.55 **Discussion Moderators:**  
*Anna Tengberg, SIWI, Sweden; Nighisty Ghezae, IFS, Sweden*
- 11.55-12.00 **Concluding remarks.**  
*Anders Malmer, SLU Global, Sweden*

# Assessing the scope for resilient crop yields through rainwater management under rainfall variability in sub-Saharan Africa

**Author:** Mats Lannerstad<sup>1</sup>

**Co-authors:** Jens Heinke, PIK, Germany, Jennie Barron, IWMI, Sri Lanka

**Presenter:** Mats Lannerstad<sup>1</sup>

<sup>1</sup> INDEPENDENT CONSULTANT

Rainfed cropping systems are key to provide food, fodder and fibre, particularly in sub-Saharan Africa, where they cover 90% of the cultivated area. However, yields are often far below potential levels. In areas with highly variable rainfall, such as semi-arid and sub-humid zones, crops are strongly affected by soil moisture constraints. This unpredictability in rainfall and soil moisture greatly increases the risks for farmers and holds back necessary investments that could enable a sustainable intensification contributing to increased harvests yields, contributing towards food security and nutrition goals.

Measures and investments in rainwater management (RWM) can overcome inter- and intra-seasonal soil moisture constraints and build resilient rainfed crop systems. This study maps where, and to what degree, rainwater management adaptation strategies can increase the resilience of rainfed crop systems to cope with rainfall variability under current rainfall regimes. The analysis uses daily precipitation data from TRMM, combined with AFSIS soil data, and a water balance modelling approach to provide daily estimates on soil moisture variability and yield impact under tree different management scenarios at 0.25-degree resolution.

Results show that on 136 Mha (60%) of current rainfed cropland in sub-Saharan Africa, the chance to achieve a full yield without rainwater management is less than 75%. On about one fourth of this land (35 Mha), the risk for a total crop failure is at least 25%. With moderate and ambitious RWM, the chances of reaching the full yield potential can be improved above the 75% level on 35 Mha and 46 Mha, respectively. On 12 Mha, the risk for a total crop failure is reduced below 25% under both RWM scenarios. However, even on most lands where full yields can be achieved with relatively high certainty, the implementation of RMW can help to a substantially prolong the growing period and improve yields.

# Success and Challenging factors to enhancing rural community resilience to drought through Rainwater harvesting in Bugesera in Rwanda

**Author:** Lazare Nzeyimana<sup>1</sup>

**Co-authors:**

**Presenter:** Lazare Nzeyimana<sup>1</sup>

<sup>1</sup> LINKÖPING UNIVERSITY, LINKÖPING, SWEDEN

By 2025, 1.8 billion people will be living in regions with absolute water scarcity and a two-third of population could be living under water stress. At the global scale, agriculture is by far the most important water user and, the need for new approaches to managing those resources is becoming more pressing.

In Sub-Saharan Africa, small-scale rain-fed farming is the main livelihood source. To increase drought resilience, there are some commendable efforts in promoting community-based soil and water conservation by governments and development organizations.

Droughts normally make their entrance quite slowly and signs should be possible to see earlier – e.g. from signs in nature, seasonal forecasts or from just comparing monitored soil moisture or other factors against the typical development during a year. But if we have early warnings and water conservations systems like that – how can that information and knowledge be used on local, regional and national level? What is missing to engage rural communities to become drought resilient by developing long-term planning based on future scenarios?

Many successful cases of rainwater harvesting documented in Ethiopia, Kenya, Tanzania and Burkina Faso describe the technical management of water conservation, but little is mentioned on their failures.

In Bugesera district, rainwater harvestings were introduced to improve living conditions by insuring food security. This case study is analyzing the knowledge gaps in addressing the challenges related to building resilience to drought with focus on Agricultural Water Management and other socio-economic capitals. The challenges to overcome in order to increase resilience to drought with consideration to multi-level actions are highlighted.

# Smallholder farmer's willingness to pay for improved irrigation water: Contingent valuation study in Mashonaland Central irrigation schemes, Zimbabwe

**Author:** Innocent Vomitadyo<sup>1</sup>

**Co-authors:**

**Presenter:** Innocent Vomitadyo<sup>1</sup>

<sup>1</sup> UNIVERSITY OF ZIMBABWE, HARARE,

Irrigation through large and small-scale water projects is playing a major role in attaining food self-sufficiency and overall agricultural development in many developing countries. Therefore, improving agriculture and enhancing productivity through smallholder irrigation is one of the key strategies for alleviating poverty and improving the livelihoods of rural communities as the majority of the poor depend directly or indirectly on agriculture. However, it has been argued that institutional weaknesses and performance inefficiencies of public irrigation agencies have led to high costs of development and operation of irrigation schemes (Gyasi et al., 2006). Given the limited capacity for maintenance support of most governments in Sub-Saharan particularly Zimbabwe, sustainable development and operation of these schemes therefore require that farmers are willing to pay for operation and maintenance cost.

While many studies on irrigation schemes have been done in Zimbabwe, farmers' willingness to pay is still not known. Hence in this study, I therefore propose to determine the smallholder farmers' willingness to pay for improved irrigation water in irrigation schemes of Zimbabwe. The study is targeting a total of 300 smallholder farmers in 5 irrigation schemes of Mashonaland province in Zimbabwe. A double bounded elicitation format and a Seemingly Unrelated Bivariate Probit Model will be used in the analysis. The study area is chosen because of the poor performance of its irrigation schemes. The results of this study will provide a way for policy makers and other institutions to formulate appropriate irrigation management systems.

## A new technology for optimizing plant available water and nutrients in root zones of permeable soils

**Author:** Libère Nkurunziza<sup>1</sup>

**Co-authors:** Ngonidzashe Chirinda<sup>2</sup>, Marcela Quintero<sup>2</sup>, Miguel Romero<sup>2</sup>, Idupulapati Rao<sup>2</sup>, Steven Prager<sup>2</sup>, Rolf Sommer<sup>3</sup>, Shem Kuyak<sup>4</sup>, Francis Lewu<sup>5</sup>, Abraham Joel<sup>6</sup>, German Escobar<sup>7</sup>, Francois-Xavier Naramabuye<sup>8</sup>, Reckson Mulidzi<sup>9</sup>, Julio Duarte Pérez<sup>10</sup>, Alvin Smucker<sup>11</sup>

**Presenter:** Alvin Smucker<sup>11</sup>

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Expanding global populations require bold agricultural solutions that provide continuous economically viable and ecologically sound improvements for both smallholder and large-scale farming systems. Our research endeavor is to develop and evaluate, under various socio-economic circumstances, a new zero maintenance technology that has the potential to transform agricultural production of highly permeable soils in tropical regions, especially on soils of arid and semi-arid areas. This so-called subsurface water retention technology (SWRT) is based on engineered impermeable water micro-reservoirs located below and/or adjacent to plant root zones. Strategically installed, either manually or mechanically into troughs, SWRT represents an opportunity to increase crop water and nutrient use efficiency. The use of SWRT membranes reduce loss of water and nutrients through deep percolation. When integrated with good management practices, efficiency of water and nutrient use increases significantly. This technology is a game-changer which functions without maintenance for at least 50 to possibly 200 years. It has been field evaluated across three continents.

We describe here how changing the soil properties through SWRT will enable maize and vegetable producers to double to triple yields on sand to loamy-sand soils while using 32 to 54% less water. These high production levels accumulate profits that return all installation investments within the first 4 years. Examples of proven results on the effects of SWRT on a range of indicators of sustainable development will be presented to encourage policy strategies aimed at promoting large-scale adoption of SWRT. Additionally, we explore creative financing mechanisms to accelerate adoption and, consequently, long-term transformation of marginal lands. The expected outcomes and potential impacts of this technology in natural resource management on the farm, and the potential to create wealth and alleviate poverty among previously disadvantaged and marginalised populations are discussed.

# Sustainable Energy Generation through Wastewater: A situation in the Urban City of Lagos, Nigeria

**Author:** Timothy Oluwagbenga Ajayi<sup>1</sup>

**Co-authors:** Olomieja Ayodele O.1, Bello Akeem A.<sup>2</sup>

**Presenter:** Mr. Buraimoh Oluwatosin Gabriel

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As Nigeria's economic capital and commercial nerve centre, the city of Lagos is undergoing speedy urbanization. With an estimated population of over seventeen million people, Lagos is one of the world's fastest growing cities. One of the prominent natural endowments that has borne the brunt of this rapid expansion is the Lagos Lagoon, a water body that has been used for sewage disposal for more than half a century. The large volume of sewage deposited in the lagoon on a daily basis has escalated due to the rapid growth in the city's population. The thrust of this paper is to explicate the repercussions of wanton sewage disposal into the Lagos Lagoon and to highlight the potential which Lagos has to generate massive energy from sewage waste in order to meet its energy challenges. From ten separate stations across the Lagos Lagoon, water samples were collected and analyzed to ascertain the existence of pathogenic entities using the techniques of sedimentation, microscopy and culture. These pH levels and Biochemical Oxygen Demand (BOD) of the samples were tested using the pH meter and BOD test apparatus correspondingly.

This paper shows that sewage disposal into the Lagos Lagoon has made the water body ecologically unhealthy for aquatic plants and animals. It has also decreased the visual appearance of the environment. Further, this cruel practice has exposed some persons that come in contact to the lagoon's waters to pathogenic infections. Extant studies have pointed to the fact that sewage waste is a key energy source, with 1 kilogramme of dry faecal sludge having a calorific value of 17.3 millijoule. This paper strongly recommends the dynamic use of faecal sludge to save the Lagos Lagoon from sewage pollution and upscale energy supply in Lagos.

## LECTURE ROOM: AULA

### **Urban and peri-urban agriculture, livelihoods, and food and nutrition security in the Global South**

SESSION LEADERS: MAGNUS JIRSTRÖM, LU; BEATRIX ALSANIUS, SLU

#### **Session schedule**

- 08.50-09.00      **Welcome and Introduction.**  
*Magnus Jirström, LU, Sweden; Beatrix Alsanius, SLU, Sweden*
- 09.00-09.20      **Heterogeneity as means to resilient urban food systems? Identification of possibilities for scale-crossing.**  
*Aniek Hebinck, Stockholm Resilience Centre, Sweden*
- 09.20-09.40      **Productive biodegradable waste management with animal feed protein production.**  
*Alice Isibika, SLU, Sweden*
- 09.40-10.00      **Forget (urban) farming? Livelihoods and the limits of urban agriculture: The case of Cape Town, South Africa.**  
*David Neves, University of the Western Cape, South Africa*
- 10.00-10.20      **How can urban livestock keeping contribute to food security? – the case of Cambodia.**  
*Gunilla Ström, SLU, Sweden*
- 10.20-10.50      **Coffee break**
- 10.50-11.00      **Towards the critical development and application of food environment research in low and middle income countries.**  
*Chris Turner, London School of Hygiene and Tropical Medicine (LSHTM), UK*
- 11.10-11.30      **Urban Agriculture in SSA: farmer and women group as the way ahead? Evidence from Thika, Kenya.**  
*Leandro Savino, LU, Sweden*
- 11.30-12.00      **Session plenary and discussion. All session participants.**

# Heterogeneity as means to resilient urban food systems? Identification of possibilities for scale-crossing

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This paper departs from the idea that the intertwined, yet fragmented nature of food systems and concentration of challenges in the urban area offer opportunities to address system failings locally and potentially globally. The urban food system consists of many activities, covering a wide range of food system actors. By mapping out these diverse urban food actors, and the different narratives and values they are shaped by, this paper provides important insights in the urban food system and possible leverage-points to further resilient urban food systems. Making food systems more sustainable and resilient remains one of today's "wicked problems". The ability of food systems to deliver its main objective of sustainable food and nutrition security is often failing and causing social and environmental vulnerabilities. Moreover, the failings that are produced by food systems especially concentrate in urban areas: over half of the world's population currently resides in cities, increasing the demand for food in these areas. There is growing consensus that multi-stakeholder governance is key to increasing sustainability; However, when zooming in on the actors that co-exist and sometimes collaborate within the urban food system, there is still a strong silo-ing in terms of practices, narratives of change and values. We demonstrate that maintaining, supporting and strengthening the heterogeneity of urban food systems, in terms of scale and narratives of change, allows for place-based approaches. On this basis, we present strategies for embracing diversity, rather than uniformity, within the food system as a key potential for urban food system resilience.

## Productive biodegradable waste management with animal feed protein production

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Ways to minimize and eventually end the usage of fish for animal feed should be sought to enhance food security and reduce poverty without compromising the fish population. Many studies have proposed alternative sources including the use of Black Soldier Fly larvae. The fly larvae convert organic substrates like kitchen wastes, manure, faeces and other organic substrate into larvae biomass that can be used as protein source in animal feed. Through this the cost of feed can be minimized and fish production increased therefore opening up new areas of business, encourage new product developments, create jobs and reduction of the environmental burden of inadequate organic waste management. The objective of this study is to evaluate the potential of producing fly larvae protein from non-utilised food industry waste. There is a lot of unutilized industrial waste fractions in the Tanzania including fruit wastes mainly associated with juice production and abattoir waste. The abattoir waste consists of easy degradable substrates that earlier studies have shown to be easy to include as substrate for protein production. The juice industry waste consist of fibrous material that can be a challenge for the fly larvae to degrade. Different pre-treatment alternatives are available for making the substrate more easily degradable by the larvae. In our studies we have looked upon using bacteria isolated from the gut of the fly larvae, Trichoderma, Rhizopus oligosporus and pure chemical treatment, all methods in combination with boiling. Results show different pre-treatment methods increased retention time, as one extra week of pre-treatment was required, however, that did not decrease the actual time of fly larvae treatment. Most pre-treatments excluding boiled ones did increase the degradability of the substrate and the larvae yield. This solution to non-utilised wastes by Black soldier fly larvae adds opportunities to improve global food and nutrition security.

# Forget (urban) farming? Livelihoods and the limits of urban agriculture: The case of Cape Town, South Africa

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Urban and peri-urban agriculture (UPA) is a source of much enthusiasm within international development circles - this paper critically considers its limits. The paper discusses Cape Town, a city of 3.7 million people, where the affluence of a world-class tourism and service economy co-exist with food insecurity amongst at least a third of households. Urban agriculture within Cape Town occupies small niches and faces considerable pressures. Despite enduring deprivation and hunger, the poorest and most food insecure are the least likely to engage in it. Instead UPA is the preserve of small agribusiness, and a hobby of the rich. Apart from unfavourable agro-ecology, the constraints on urban agriculture are essentially twofold. The firstly is the persistence of an apartheid-era (racial) spatial regime, which excludes the poor from economic opportunity and access to land. It is exacerbated by systemic urban planning failures, and the untrammelled market logic of property values. The second constraint is the inhibiting effect of the concentrated, vertically integrated, corporate-dominated agro-food system. South Africa's formal agro-food system is comparatively 'efficient' by conventional metrics, but 'crowds out' potential small scale (Black African) producers, processors or vendors. Apart from the adverse livelihoods consequences, these dynamics are intertwined with unfavorable nutritional outcomes. South Africa exemplifies the emerging global 'double burden' of malnutrition: evident in simultaneous (child) under-nutrition, alongside rising (adult) obesity and non-communicable disease. It is argued that while these dynamics are extreme in the context of Cape Town, they are far from exceptional across the Global South. In Sub-Saharan Africa rising 'jobless de-agrarianisation' sees the loss of rural livelihoods unmatched by emerging urban opportunities. It moreover coincides with the reconfiguring of national agro-food systems, and their penetration by multinational food processors and supermarkets. These are adverse structural dynamics that UPA is likely to, at very best ameliorate, rather than fundamentally alter.

# How can urban livestock keeping contribute to food security? – the case of Cambodia

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## Background

As a consequence of population growth, urbanization and higher incomes in many low-income countries, the demand for animal-source foods has increased rapidly. This demand has contributed to an increased relocation of livestock production to the vicinity of urban areas, where it may provide possible income-opportunities for poor urban dwellers and contribute to improved food security and nutrition. Besides contributing to increased income and better nutrition, livestock may play an important role in reducing and re-using organic waste from markets, restaurants and industries located in these areas. Keeping animals in densely populated areas, however, may increase the risk for zoonotic disease transmission and may hence pose a public health hazard.

## Methods

This study included 204 households keeping pigs, cattle and chickens in Phnom Penh, Cambodia. Semi-structured questionnaires were used to gather information on household characteristics and animal husbandry.

## Results

In the majority of the households, livestock production was considered to be of great importance for livelihoods. Many households reported to keep livestock as a part of an integrated production system, where residues from food and rice wine production were used as animal feed. Around 52% used organic waste as feed for the animals, of which 82% used household kitchen waste and 52% used waste from nearby restaurants. However, a quarter did not always cook the waste before feeding and almost half of the respondents did not wash their hands properly after handling the animals.

## Conclusion

Keeping livestock enables an important extra income and may also contribute to improved livelihoods and food security for urban households. Keeping livestock, and especially pigs, in these areas also provides an opportunity to re-use organic waste that would otherwise likely be discarded or put to landfill. It is, however, important that proper biosecurity measures are implemented, in order to mitigate the public health risks.

# Towards the critical development and application of food environment research in low and middle income countries

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The food environment is the interface that mediates one's food acquisition and consumption within the wider food system. Food environments provide the foods that people encounter as they go about their daily lives and activities, and include market sources, own production, and gifts. Socio-ecological interactions between people and their food environment shape food acquisition practices.

To date, research into food systems and public health nutrition in low and middle income countries (LMICs) has had a tendency to focus on food production, availability, household food security, and individual consumption patterns. However, research into how people interact with their food environment remains scarce. There is limited situated knowledge and understanding about food acquisition practices and the the who, what, when, where, why and how of food acquisition. Further, there is a need to address complex interactions between the availability, accessibility, affordability, desirability, convenience, marketing, and properties of diverse food sources and products.

We argue that the contextualized development of food environment research in LMICs provides a new lens to address food security and malnutrition in all its forms, including persistent maternal and child undernutrition and emerging rapid increases in obesity and nutrition related non-communicable diseases.

We present key concepts, theoretical frameworks, and methodological approaches for food environment research in LMIC settings. We further outline research gaps and key considerations, as well as present novel qualitative methods currently being implemented in a transitional, rapidly urbanizing setting in Telangana, India.

## Urban Agriculture in SSA: farmer and women group as the way ahead? Evidence from Thika, Kenya

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Population growth, urbanization and food security are main current and future challenges to sustainable development in SSA. This study showed that urban agriculture, UA, proved to be a livelihood strategy (or part of a diversified livelihood strategy) for around 25% of the urban population living in Thika, Kenya. Urban farming, besides creating additional income and/or additional food to urban households, contributes also in three other different ways, including (1) the improvement of resiliency towards external factors (e.g. food price fluctuations), (2) the improvement of self-sufficiency (e.g. rely less on food transfers) and (3) the easiness in selling the agricultural production (at farm-gates or local markets).

However, the study also reveal a significant difference in the access to credit and training between farmers who are members of a farmer/women group and those who are by themselves only. This difference includes also a lack of information on possibilities available from the local government and, consequently, a different perception of local authorities' actions. In this scenario, farmer and women groups may play a crucial role between the two sides (local government and farmers), by allowing access to training, credit and information for the urban farmers. A qualitative study conducted in Thika during May 2017 was used to collect information on such issues. The study was based on 33 interviews with urban farmers as well as an interview with representatives of local livestock authority, which further clarified the position of the local government in relation to UA and to private/civic associations such as farmer and women groups.



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