

# Invited Abstracts

*Listed in presentation order*

## **Pathways for the sustainable development of agriculture**

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Sustainable development is at the top of the most challenging tasks facing humanity, and agriculture, being the largest business in the world, has a key role to play. The largest potential for the sustainable development of agriculture exists in parts of the world where most of the population is involved in small scale farming (up to 90%), and where the demand for food and levels of poverty are the largest e.g. Sub Saharan Africa. However, given the large diversity of agro-ecological, socio-economic and market conditions smarter approaches are required to guide investments and interventions that bridge the gap between present and achievable levels of farm production. Here we show how data from a household survey (n=800) and a whole farm model (APSFarm-LivSim) could be combined to describe likely pathways of agriculture intensification. Intensification pathways were defined in terms of the effects of increasing on-farm investments on the reduction of down side risks i.e. the likelihood of not producing enough food as per the household energy requirements; as a function of the household potential for intensification i.e. difference between present and achievable levels of production. Three types of pathways were identified: (i) a low risk pathway; (ii) a high risk pathway; and (iii) and a group of households that are likely to remain food insecure after intensification took place. Implications for on farm investment and practice change are discussed in terms of the socio-economic and bio-physical characteristics of the component households from each pathway type.

## **Co-designing the transitions towards integrated market oriented mixed farming systems in semi-arid Zimbabwe**

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In semi-arid Zimbabwe, multiple constraints impact maize-based crop-livestock systems creating a poverty trap. These barriers include low soil fertility, variable climates, weak knowledge support, and lack of markets. Conventional technical options are insufficient to improve smallholder livelihoods. Given the diversity in resource endowments and livelihood sources identifying intensification options that fit circumstances remains problematic. In this paper we demonstrate co-designing approaches (i.e. with multiple stakeholders) for two sites i.e. Gwanda and Nkayi districts, of contrasting agro-ecological potential. We engaged low, medium and high resource endowed farmers to (i) co-design plausible improved scenarios that included incremental changes - testing currently promoted technologies for crop-livestock intensification and drastic change - assuming that removing barriers will encourage investments towards resilient and profitable

farming; and (ii) We quantified benefits and trade offs from alternative integrated actions using an integrated whole farm modelling approach (APSFARM-LivSim-TOAMD). At both sites incremental change options improved food security through better-integrated cereal-legume-livestock systems; income effects were however limited. Drastic change options achieved more substantial improvements in productivity, food and income generation: farmers set more land in use, with more diversified forage, food and cash crops and adapted cultivars, organic and mineral fertilizer application, small-scale mechanization for ploughing and product processing and improved livestock management. Packages tailored to farm situations had larger benefits on food security and income than blanket applications. Recommendations that take into account the socio-economic context and policies are key and need to be communicated in more effective ways for enabling more sustainable futures for smallholders in Zimbabwe.

### **Financial and opportunity costs of agricultural labour in Cambodia: implications for rice production technologies**

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Smallholder farmers in developing countries are witnessing rapid social and economic change with new opportunities for use of farm-family resources. Subsistence, and semi-subsistence, rice production is the mainstay of agriculture in Cambodia. Off-farm work opportunities now provide alternative and economically appealing uses for family labour, with labour migration and remittances becoming important livelihood options. Traditional scientific Research and Development (R&D) continues to develop new rice technologies, but often without substantial impact. We assessed the incentives to adopt new rice production technologies by accounting for the full financial and opportunity costs of labour. We constructed a representative whole-farm model of lowland rice production set in a constrained optimisation framework with an economic objective, and developed detailed seasonal labour demand (for alternative crops) and labour supply (from family labour) functions. We assessed a new rice technology in a farm-focussed analysis and then in a wider farm-livelihoods analysis when off-farm work options are included. When the opportunity cost of labour is zero the improved rice technology is 'best' for family income. But when off-farm work options are included, so that the opportunity costs are real, the technology choice is reversed. The implications for R&D funding bodies, and government policy-makers and extension services, are that failure to account for economic and social factors operating in 'target' farm populations may explain why some adoption of new technologies is less than expected, and that improved scoping and targeting of individual projects may increase returns to R&D investments.

### **The digital frontier and the northern beef industry**

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