Info Note

Smallholder farmers' innovation systems in climate-smart agriculture

Interview findings from Tanga Region, Tanzania

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Key messages

- Innovation is an ongoing, non-linear process of change that involves a wide range of stakeholders. A farmer-oriented perspective of innovation helps understand why some people engage with and derive benefits from climate-smart agriculture (CSA) programs, and others do not.
- Defining innovation in a way that represents the reality of smallholder farmers is a necessary first step in evaluating progress in CSA programs. Binary notions of 'adopters' and 'non-adopters' does not reflect the non-linearity of innovation, nor the dynamic application of CSA technologies and practices.
- To support the least able, intervention design should be shaped with communities to reflect the context, and programs should meaningfully engage with existing power dynamics to ensure inclusivity.
- Efforts to promote CSA should support off-farm activities, as farmer innovation is dependent on off-farm enterprises.

This Info Note summarizes the findings of 228 interviews with smallholder farmers participating in two CSA interventions in Tanga Region, Tanzania. The study examines how agricultural innovation happens in the context of CSA interventions, and explores differentiated experiences of innovation within and across the two case study programs. Through exploring innovation processes, this brief highlights the diversity of actors, approaches and outcomes of CSA interventions, who does and does not benefit, and raises questions about the viability of, and challenges with global ambitions to upscaling CSA.

CSA interventions in Tanga Region

We examined two interventions implemented in similar agroecological contexts in adjacent Districts of Tanga Region in Tanzania: the European Union's Global Climate Change Alliance (GCCA+) funded 'Integrated Approaches for Climate Change Adaptation in the East Usambara Mountains' (henceforth IACCA); and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) implementation of Climate-Smart Villages (henceforth the CCAFS-CSV) in the West Usambara Mountains.

IACCA was a four-year program implemented between 2015-2019 by ONGAWA and Tanzania Forest Conservation Group, in partnership with Muheza District Council. The program implemented a suite of activities, including training and promotion of CSA techniques, alongside financial mechanisms (loan and savings groups), community-based forestry, income-generating activities (e.g. beekeeping, butterfly farming, tourism), improved cooking stoves, watershed conservation and sanitation. The program objective was to demonstrate effective and efficient strategies that support poor, rural households to adapt to the negative impacts of climate change, and to alleviate poverty.

CCAFS-CSV was a partnership between CCAFS, Tanzania Agricultural Research Institute and Lushoto District Council, operating since 2011. The program focused on CSA activities, facilitating the testing and scaling up of improved crop and livestock production practices, promoting integrated land and water management practices, weather forecasting and building local institutions. The program goal was to reduce hunger, ensure food and nutritional security and improve household incomes, by enhancing communities' understanding of climate risks for improved agricultural decision-making.

Re-thinking innovation in CSA

Innovation is an ongoing process of change. It is complex, non-linear and includes diverse stakeholders, such as farmers, scientists, educators, supply chain actors and government officials.

Innovation is more than technology, it is the integration of three interconnected components: Orgware, Software and Hardware (Smits 2002):

- **Orgware** describes the ordering of formal and informal institutions and organizations.
- **Software** includes knowledge, processes and models of thinking, teaching and learning, language and communication.
- **Hardware** comprises the use of technologies or practices, such as genetic modification, biochar, precision fertilizer and irrigation, conservation agriculture and agroforestry.

In CSA interventions, particularly in the context of programs where smallholder farmers are intended beneficiaries of innovation, the framing of Orgware, Software and Hardware is limiting as it fails to understand the complex dynamics and differences between smallholders.

A farmer-oriented perspective of innovation (Fig 1.) helps to explore the diversity of innovation processes, to understand why some people engage with, and derive benefits from CSA programs, and others do not.

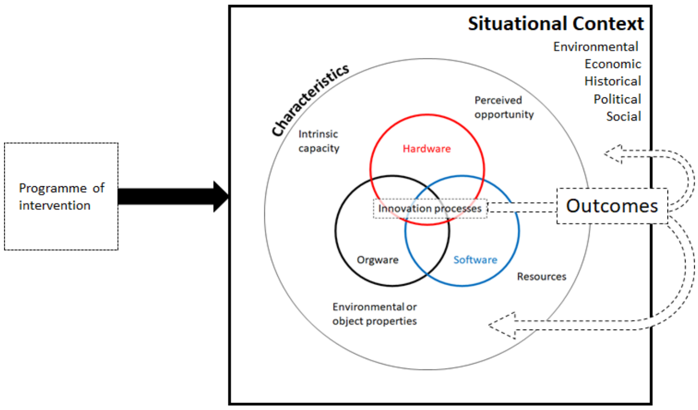

Figure 1. Smallholder farmer innovation framework.

Farmers' abilities to attend and understand training sessions, use a particular technology or practice, and realize benefits, depends on their individual **characteristics**. These include their **intrinsic capacities** (e.g. their knowledge, intelligence, physical strength etc.), their **resources** (e.g. financial, land, labor etc.) and the **properties of the objects** (e.g. a technology) or **environments** with which they interact. Likewise, innovation processes are embedded into the broader **situational context**. A more farmer-oriented perspective of innovation is therefore helpful, to recognize differences between individuals, over time.

Differentiated experiences of innovation

Orgware component

Both programs created farmer demonstration groups and village savings and loans associations to support CSA implementation and upscaling. The IACCA program prescribed gender-equal representation for the farmer group membership, with requirements for members to represent more vulnerable backgrounds. In contrast, in the CCAFS-CSV program farmers were randomly selected though simple random sampling from the humid warm and humid cold zones whereby farmers were picked from a list compiled by CCAFS and partners (Lyamchai et al. 2011).

Despite the voluntary nature in IACCA membership, experiences of group exclusivity and favoritism in the selection process were reported. Interview responses also highlighted numerous challenges in session involvement, particularly for labor-intensive activities such as the construction of terraces and farm maintenance. Conflicting activities, such as attending livestock, childcare, running of a business, ill-health and old age, were often unavoidable challenges in attending training sessions. Those most affected tended to be from more marginalized backgrounds, particularly women and the elderly.

In both programs, savings and loans groups were anticipated to support farm investments alongside other household activities, such as education costs. Participation in these financial institutions however was limited to those with sufficient economic resources required for initial and continued deposits and repayments; anxiety about repayments and lacking trust in other members' ability to repay were common reasons for non-participation.

Reports of favoritism within the IACCA farmer group membership and of financial prerequisites to join savings and loans groups, demonstrate how power inequalities generate differentiated outcomes for innovation processes. Even when efforts were made for inclusivity, such as the request for gender representation and of members from poorer backgrounds in the IACCA, inability to deal with existing social and power dynamics influences the process in which members are selected and are able to engage, and leads to membership formation that reinforces prevailing power hierarchies. Furthermore, whilst the random approach adopted by the CCAFS-CSV program circumvented some of the challenges found in the IACCA program, bypassing elite groups can create friction in communities (Jabeen 2018).

Software component

Diverse sources of information and learning experiences were documented across the study sites. Much learning occurred through independent experimentation, whereby farmers trialed technologies or practices, either purposefully or for lacking resources, or by comparing techniques used by other farmers. However, experimentation required the ability to carry risk of failure, so experimentation was limited to those with more resources, and was typically initiated on a small scale.

The differentiated learning experiences in both programs highlight various challenges in accessing knowledge and learning. These include, for example, challenges respondents' faced attending training sessions due to age or unavoidable household responsibilities, which are often complex and gendered. Other learning experiences were associated with the level of capital and risk capacity of an individual, where farmers with more financial capital can carry more risk, and thus experiment more.

Concern of deviating from the 'correct' implementation was occasionally raised during interviews, and altering a practice learned from an 'expert' was deemed unthinkable for some. Narratives of farmers reluctant to adapt a learned hardware, however, raises concerns, as this may reduce the relevance of inherent experimentation and local knowledge. This may ultimately undermine innovation processes and CSA program objectives, as indigenous knowledge is considered a critical component of climate adaptation and in scaling CSA (Makate 2019).

Hardware component

Changes in farming practices were diverse, temporally variable and linked to farmers' intrinsic capacities, their resources and the situational contexts. In some cases, a few farmers voiced no desire to change practices at all. Finances, labor availability and markets were identified as intrinsic to decisions around farm management practices. Economic resources were the main limiting and enabling factors for the majority, particularly for high-investment inputs such as chemicals, manure, improved seed varieties and labor-intensive activities. In certain cases, receipt of free inputs and training on a particular practice did not lead to their continued usage.

Continuation of capital-intensive hardware required farmers to generate resources, larger re-investments were often dependent on consecutive successful harvests. However, these were highly vulnerable to factors including weather variability (drought, heavy rain and delayed rainfall onset), crop pests and diseases, market fluctuations, theft and ill-health. Those lacking financial resources explained how they would switch between high and low cost inputs, or temporarily stop or reduce certain activities.

Because of such challenges, application of hardware is transient and dynamic, emerging alongside, and in response to the context and conditions of farmer livelihoods. Some farmers reduced their use of a particular technology or temporarily 'dis-adopted' or switched to lower-costing practices. Re-adopters, along with pseudo-adopters, (i.e. farmers who use a practice in order to receive benefits from projects) are poorly recognized in program evaluation, which typically oversimplify the complexity of innovation.

These findings add nuance to recent reports demonstrating widespread uptake of CSA technologies in Tanga Region (Ogada et al. 2020), as we find evidence of short-term application of technologies, where key limiting factors such as insufficient labor and finances constrained farmers continued use.

Conclusions and policy implications

CSA success stories support global efforts towards 'scaling up' practices and technologies that 'work'. However, these success stories mask how and why technologies and practices are unequally experienced across time and space. Beyond identifying and upscaling technical solutions to climate challenges (Taylor 2018), more effort is now required to recognize diversity among farmers' dispositions towards certain practices, identifying inabilities and abilities to employ them.

Rethinking innovation, and the ways in which change in agricultural systems happens and why, can support farmers, including those that are less able, engage with innovation processes. A farmer-oriented perspective helps understand why some people engage with, and derive benefits from CSA programs, and why others do not. With these considerations in mind, we summarize four lessons learned to support future design of CSA programs that engage with the least capable from the beginning.

- Context (historical, environmental, social, economic, political) shapes farmers' intrinsic capacities and resources, affecting innovation processes and determining the outcomes of interventions and the benefits people obtain. Failure to consider the context risks undermining program objectives and creating unintended outcomes.
- Implementing CSA in agricultural communities risks reinforcing prevailing power hierarchies, further excluding marginalized groups and widening inequalities. Programs should therefore consider how they will meaningfully engage with existing power dynamics to support inclusivity and build in regular evaluation and reflection.

- Interactions between all components of innovation processes (Orgware, Software and Hardware) reflect the dynamic and diverse farm-systems and farmer livelihoods, and recognize that innovation pathways draw on a range of resources, including off-farm activities and enterprises. Programs should consequently support off-farm activities to nurture on-farm innovation.
- Narrow metrics for program monitoring, evaluation and reporting cannot account for the dynamics and nonlinearity of innovation processes and risk overlooking unintended outcomes. Combining quantitative and qualitative methods, including ethnographic approaches, whilst ensuring sampling considers contextual inequities, will help support more holistic and nuanced understandings of program outcomes and innovation processes.

Further Reading

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