

Adapting Conservation Agriculture to Local Contexts in Mozambique – the Role of Farmers' Participation and Innovation Networks

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Agricultural technologies, such as conservation agriculture (minimum tillage, mulching and crop rotations), have the potential to dramatically improve smallholder livelihoods but must be locally adapted. In this *flash* we examine the role for farmers' participation in locally adapting conservation agriculture (CA) and the challenges researchers and development agencies face in using innovation networks for CA adaptation. We find widespread agreement among researchers and program managers about the need to locally adapt CA but farmers' involvement in research is limited to managing researchers' experiments. In contrast, some NGOs work collaboratively with farmers through Farmer Field Schools to adapt CA to the local context. We also find widespread agreement about the importance of establishing links across the value-chain, and we document lessons from nascent efforts to accomplish this. The results also indicate that effective collaboration will require coming to terms with polarized disagreements on two key issues: the importance of emphasizing minimum tillage and the role of commercial inputs for CA.

Introduction

The development of improved agricultural technologies has tremendous potential for improving the livelihoods of smallholder farmers in least developed countries. Sets of technologies such as conservation agriculture (minimum tillage, mulching and crop rotations) have the potential to sustainably increase yields and decrease farmers' vulnerability to climate change (Rockström et al., 2009). However, the linear technology transfer approach (from research stations to farmers via extension) has failed to produce technologies that most farmers can adopt where farming systems are integrated into complex livelihood systems and agro-ecological conditions are diverse (Buhler et al., 2002). In contrast, high levels of adoption have been achieved in complex contexts when innovation networks are used to locally adapt agricultural technologies (Ekboir, 2003). An innovation network allows interdependent actors (such as farmers, input suppliers, buyers, extensionists and agricultural researchers) who cannot meet their innovation objectives independently to come together to collectively facilitate the innovation process (Klerkx et al. 2010).

The need to adapt conservation agriculture (CA) to the local context of smallholder farmers has been well established in the literature (Giller et al., 2009; Wall, 2007). This is primarily because the benefits and challenges associated with reducing tillage are

variable across crop, soil types and rainfall regimes (Giller et al., 2009; Baudron et al., 2012, Ekboir, 2002). Furthermore, there are a wide range of minimum tillage technologies (basins, jab-planters, ox-drawn rippers, tractor rippers), each with different labor, knowledge and financial requirements for effective use. CA promotion in southern Africa has been criticized as being overly prescriptive (Andersson and Giller, 2012) and lacking in the critical reflection of evidence that is needed for effective adaptation (Whitfield et al., 2015).

In this *flash* we aim to understand researchers' and program managers' perception of the need for adapting CA to the local contexts and how farmers are currently involved in the process of adaptation. We also aim to identify obstacles that hinder the use of innovation networks (including farmers, input suppliers and extensionists) in the technology adaptation process. We take the need for participation as the starting point for technology development due to the wide support of its importance in the literature.

Methods

We used the following data collection activities to meet these goals: 1) an inventory of CA research and promotional projects, 2) a review of the literature on the performance of CA across the country, 3) a survey of CA researchers and program managers,

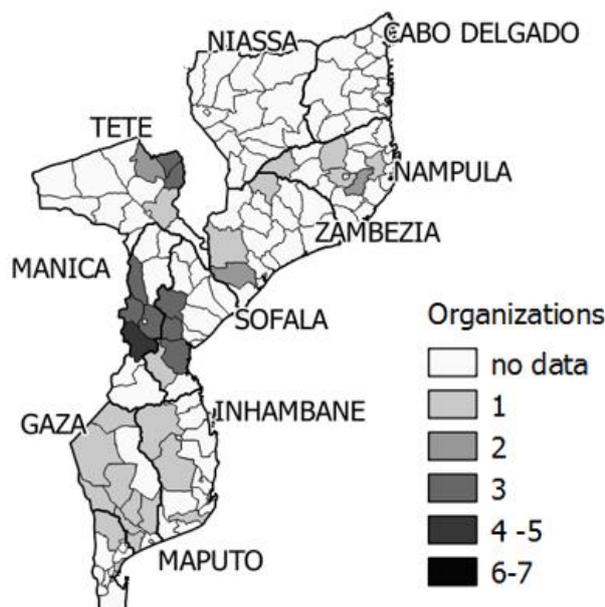
and 4) in-depth interviews with key informants implementing CA projects that involved farmers and actors across the value chain in local adaptation. The inventory documented the efforts of 29 development organizations, 10 research organizations and 5 private sector organizations actively promoting CA. A two-round on-line survey of 43 researchers and project managers experienced with CA in Mozambique was used to obtain their perspectives on what was necessary to promote CA in a way that would result in wide-scale adoption.

Adapting CA to the local context

CA promotional and research efforts are widespread across Mozambique, with active programs in at least 84 of the 128 districts of Mozambique (81 districts with promotion and 33 districts with research, Figure 1). Respondents generally agreed that the existing CA technologies are not ready for widespread dissemination but need significant local adaptation.

Respondents' priorities for achieving widescale use of CA highlight the need for locally adapting CA technologies to meet the needs of resource-poor farmers. Priority research activities included adoption/disadoption studies in different agro-ecological zones and socio-economic studies. This suggests the importance of understanding context-specificity, as well as farmers' perspectives and motivations. Respondents also prioritized more farmer-led development initiatives and long-term projects (greater than 5 years), as are often necessary for participatory projects. Dissemination activities that were prioritized included the establishment of demonstration plots and training for extension workers (both public and private). Presumably these

Figure 1. Number of organizations researching CA by district



Source: Inventory of CA organizations, 2012

must come after appropriate CA technologies have been developed.

In addition, respondents also emphasized the need for long-term agronomic and soil science research to better understand the subtle and hard to measure effects of implementing CA principles. This combination of prioritizing both localized adaptation and long-term scientific research highlights the need to draw on both farmers' and scientists' expertise. Literature from technology development documents how participatory research can be used to effectively solve agricultural problems through the collaboration of farmers and scientists.

Table 1. CA experiences by province (no data for Niassa and Zambezia)

Province	Primary agriculture system targeted	Unique opportunities for CA	Unique challenges for CA
Cabo Delgado	Maize low input	Mulching with grass	
Nampula	Cassava		Minimal research on CA with cassava
Sofala	Horticulture		
Manica	Maize – high input	Adequate rainfall, Some animal traction	Termites, input prices
Tete	Maize – high input		Input prices
Gaza	Maize and cowpea	Animal traction	Very arid
Inhambane	Maize – low input		Sandy soils, arid
Maputo	Horticulture		

Source: Literature review and inventory of CA organizations, 2012

Farmer participation in CA adaptation

The on-farm research on CA in Mozambique is typically carried out with limited participation from farmers. In most cases farmers are contracted to manage researcher-designed experiments. There were no cases of CA research implemented where farmers were involved with researchers in designing and implementing the research and interpreting the results.

Nevertheless, collaborative levels of participation in the adaptation process were observed in some exceptional CA promotional efforts. These efforts used the Farmer Field School (FFS) approach to evaluate and improve the CA technologies promoted by their development projects. In the FFS methodology a group of about 20 to 30 farmers participate in regular meetings in a field with an outside facilitator to compare and adapt promising agricultural practices. While the institutions (NGOs and extension) using this approach have expertise in working with farmers to adapt the technologies, their lack of formal agricultural research skills means they are generally lacking the ability to determine how such adaptations will affect long-term soil fertility.

Linking actors across the value chain

Researchers' and project managers' priorities indicate widespread recognition of the importance of linking actors across the value chain. One of the prioritized policy actions was ensuring that both input and output markets work better for smallholder farmers. In Mozambique value chains are relatively weak and undeveloped. Many forms of CA require commercial inputs such as equipment, herbicides, improved seeds and chemical fertilizer. Even with low input forms of CA there is increasing evidence that farmers' motivation to invest in increasing productivity is contingent on reliable marketing systems so that farmers can respond to market demand (Benfica et al., 2014).

Nevertheless, most CA promotional efforts in Mozambique either focus only on the farmer or try to improve one link in the value chain, such as helping farmers market their crops or tailoring fertilizer supply to smallholders' needs. Two organizations are actively linking actors across the value chain in association with CA. SIMLESA (Sustainable Intensification of Maize and Legumes in Southern Africa) is a research project that uses innovation networks, and ECA (Empresa de Comercialização Agrícola) is a contract farming

operation that links farmers with inputs, credit and markets.

Through these efforts agro-dealers have been learning how to provide products demanded by farmers and over time they have become motivated to participate in the forum for their own benefit. Farmers have also benefited from the contracts that ECA established with large-scale buyers of grain, with a guaranteed price set at the start of the season. This allows farmers to reduce the risk of investing in CA inputs.

The output buyers in the SIMLESA project however have not been enthusiastic so far because the organized farmers have been trained to negotiate for higher prices. This highlights the key challenge of motivating participation across the value-chain. Traders of agricultural outputs may be more motivated to collaborate where they benefit from farmers being organized, such as where monitoring quality is important or where the timing of bulk sales requires coordination.

Challenges for Increasing Collaboration

Using innovation networks with high levels of farmer participation to adapt CA technologies will require collaboration at two levels: 1) among researchers, extension and private sector actors across the value chain, and 2) between researchers and resource-poor farmers. Any collaborative effort on CA in Mozambique will have to be aware of and either resolve, or learn to live with, polarized disagreements on two key issues: the importance of emphasizing minimum tillage and the role of commercial inputs for CA. Researchers will also need institutional support to carry out this collaborative effort.

1. Debating emphasis on minimum tillage

During the inventory, it became clear that several NGOs promoting CA in Mozambique were not emphasizing minimum tillage, which suggests divergent definitions of CA. We asked respondents for their opinions about incorporating residues through complete tillage. About one third of respondents said tillage to incorporate residues was very important and better for the soil than burning the residues. Another third said it was not important, arguing that tillage is incompatible with CA and should not be practiced. They pointed out that promoting CA without emphasizing minimum tillage means ignoring the problems associated with tillage,

such as erosion, loss of both soil organic matter and soil structure.

While minimum tillage need not be emphasized as the first CA principle (though it often is), completely neglecting it creates difficulty in defining the term “conservation agriculture”. Though there is a risk in being overly prescriptive if CA is defined too narrowly, there is also a risk of the term becoming meaningless if every improved agricultural practice can be labeled as CA (Andersson et al., 2014). Instead, where minimum tillage is not possible for farmers, technologies other than CA can be promoted, even if the theoretical benefits are less.

2. *Divergent perspectives on the role of inputs in CA*

Divergent opinions about the importance of commercial input use with CA is another area of tension that can constrain collaboration. Some scientists and development practitioners see fertilizer, herbicides and improved seeds (such as hybrid maize) as key tools for modernizing the smallholder sector. But others see promotion of these inputs as problematic because of farmers’ lack of access, and because of concerns for environmental sustainability and social equity.

One third of the respondents stated that CA without these inputs was not even feasible. Another 20% stated that low-input CA was feasible, pointing out that farmers do not have access to inputs so this is the only option available for most in Mozambique. Other respondents emphasized that they have observed CA benefits even without purchased inputs. This divergence of opinions is especially noticed in maize-based systems where fertilizers can dramatically boost yields, though inputs such as herbicides are relevant to cotton and cassava systems as well.

There are many biological and economic arguments that can be made on both sides of this debate. Those who favor commercial inputs tend to focus on yield potential and the subsequent profits from marketing the increased production. In contrast, those who favor low-input CA emphasize self-sufficiency and environmental integrity.

It is important to recognize that these divergent opinions do not necessarily stem from scientific uncertainty, but reflect differences in values, priorities and worldviews. A good first step for collaboration is helping all sides to listen and

understand each other, realizing that effective collaboration does not require consensus on these issues, but rather respecting each other’s perspectives. From a pragmatic perspective low-input CA technologies have the short-term advantage in Mozambique, where commercial inputs are largely unavailable and unaffordable, as long as weeds can be effectively controlled.

3. *Institutional support for collaborative research*

For the Mozambican Ministry of Agriculture to support a process of participatory collaborative agricultural innovation, it will have to face the institutional challenges of managing evolving research processes that are tightly linked to non-research stakeholders. Organizational change from a hierarchical bureaucracy to an egalitarian learning-focused institution is essential but will require courageous leadership. The national CA working group is a good start at effective collaboration linking researchers, NGOs and extension together. This group has made the first steps in developing regional working groups that can foster local collaborative efforts that are closer to farmers’ realities.

Collaborative efforts to locally adapt agricultural innovations would also be assisted by bringing the research and extension branches (IIAM and DNEA) into closer coordination. The challenges of achieving such coordination in other countries suggest that patience and perseverance will be needed (Merrill-Sands et al., 1991; Biggs, 1995). Establishing effective two-way communication between research and extension requires creativity to join these efforts in their common goal of rural poverty alleviation (Biggs 1995). One of the barriers experienced in other countries is that of valuing extension less than research rather than recognizing the complementarity and interdependence of the two institutions (Buhler et al., 2002). One promising development is that the Platform for Agricultural Research and Technological Innovation is considering how to be jointly managed by both the extension and research branches of the Ministry of Agriculture.

Conclusion

Adapting CA to the local contexts across Mozambique can be facilitated through research that has high levels of farmer participation and collaborates with actors from across the value chain to overcome bottlenecks to production.

History shows that farmers around the world continuously innovate and adapt technologies as well as they are able. Research and development agencies have the opportunity to support this process of adaptation and accelerate the innovation process by partnering with farmers and helping link them together with actors across the value chain. Adapting technologies to local contexts so that they can be effectively used by smallholder farmers has great potential for improving the livelihoods of the rural poor.

For researchers and development agencies to effectively support local adaptation of CA through innovation networks they will have to overcome the following challenges: 1) polarized disagreements on the importance of emphasizing minimum tillage and the role of commercial inputs for CA and 2) the institutional challenges of managing evolving research processes that are tightly linked to non-research stakeholders

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