



Making agricultural intervention attractive to farmers in Africa through inclusive innovation systems

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ABSTRACT

Effectively identifying and integrating the fundamental issues that guide Sub Saharan Africa (SSA) farmers' management decision in their quest to meet the household food security and income generation targets into agricultural intervention planning is perhaps the most important challenge to unlock current technology adoption traps and identify feasible pathways to actively engage farmers in the co-design of profitable and resilient farming systems. The challenge is exacerbated by supply driven intervention approaches designed mainly to improve agronomic responses through single sized technological packages, that are failing to unmask the social contours of technology adoption in Africa. The highly diverse farming environments, contrasting socioeconomic contexts and circumstances where agriculture takes place in Africa, calls for a renewed look into the understanding of the social drivers of technology adoption. Here, understanding how the whole farm enterprise functions and is managed is critical to tailor agricultural intervention. In this short review, the research gaps and recommendations for the validation of integrated and sociotechnical intervention approaches that are more likely to improve farmers' engagement and technology adoption in Africa are discussed.

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1. Introduction

Improving Sub-Saharan Africa (SSA) smallholder farmer's food security and income generation prospects through an active

engagement in sustainable and profitable farming systems is a major challenge of the agricultural authorities and development partners in Africa (OECD, 2012). Despite the historical low public expenditure in agricultural research and development in Africa (Allen & Ulimwengu, 2015; Stads & Beintema, 2015) several efforts to design and validate productive, profitable and environmentally friendly agricultural systems have been promoted in SSA over the years. Conservation agriculture (CA) (Wall, 2007), integrated soil

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fertility management (ISFM) and improved inorganic fertilizer recommendations (Chianu, Chianu, & Mairura, 2012; Gilbert, 2012), sustainable intensification (Gadanakis, Bennett, Park, & Areal, 2015; Lipper et al., 2014) and climate smart agriculture (Arslan et al., 2015; Petersen & Snapp, 2015) are part of the vast array of agricultural paradigms promoted across Sub-Saharan Africa (SSA) in an attempt to promote a long lasting agricultural development. Conservation agriculture and efficient fertilizer use in particular have deserved much attention in Africa.

Despite all the effort, conservation agriculture adoption (Baudron, Thierfelder, Nyagumbo, & Gérard, 2015; Stevenson, Serraj, & Cassman, 2014), and fertilizer recommendations are still unattractive to most cash constrained farmers (Chianu et al., 2012; Rware et al., 2014). Nevertheless, not only conservation agriculture and fertilizer use adoption rates are low in Africa (Asfaw & Shiferaw, 2010). Most agricultural technologies promoted to date failed to match farmer's real development priorities, therefore were poorly adopted. This raises questions over the way technological innovation are being promoted in Africa. In part supply driven interventions that are not reflective of farmers circumstances have failed to stimulate farmers' effective engagement and trigger adoption. Therefore, a paradigm shift in agricultural intervention in SSA is much needed (Sanyang, Taonda, Kuiseu, Coulibaly, & Konaté, 2016).

Recent research in Africa, has demonstrated that rather than access to inputs and production means itself, understanding resource management strategies, i.e., allocation across activities within the farm household enterprise (Bucagu, Vanlauwe, Van Wijk, & Giller, 2014; Giller, Rowe, de Ridder, & van Keulen, 2006; Rusinamhodzi, Dahlin, & Corbeels, 2016) plays a key role in the effective design of resource efficient and sustainable farming systems (Tittonell, Vanlauwe, de Ridder, & Giller, 2007; Tittonell et al., 2010; Vanlauwe, Tittonell, & Mukalama, 2006). This because, the complexity of the situation in Africa involves not only resource access and use, crop and site responses, but also risk perceptions, values, and aspirations of poorly resourced farmers. Therefore, a better understanding of the whole farm household functioning, i.e., livelihood strategy and the household decision making process in the pursue of their food security and income generation goals is critical.

This article argues that farmer's perception of their biophysical and, socioeconomic circumstances directly affects their resource use behaviour, farming systems design and the likelihood to engage in new practices. Therefore, an integrated sociotechnical approach that looks at the interlinkages between household decision making processes and its impact on whole household livelihood strategy rather than linear and technical field level interventions is paramount to trigger an effective change of practice. To help address key technology adoption traps in Africa, this short review discusses three key areas of intervention that are critical for the co-design and implementation of locally feasible and effective agricultural intervention programs.

2. The context matter: agroecological and socioeconomic context shape farmers' views and intervention capacity

The contrasting biophysical, socioeconomic and structural context where agriculture is practiced in Africa, makes farming an extremely context bounded activity at both regional and household level. Therefore, agricultural intervention in Africa, needs to be tailored to match regional and household development goals and intervention capacity (Baudron et al., 2015; Giller, Witter, Corbeels, & Tittonell, 2009). For that to happen, understanding how households of contrasting socioeconomic background within and across agroecologies perceive their biophysical and socioeco-

nomical circumstances and the way those same perceptions affects their farming systems design and management is critical (Zingore, Murwira, Delve, & Giller, 2007). This because farmer perceptions dictate how they plan their farming and overall household livelihood strategy to effectively react to the challenges presented by their surrounding environment (Meijer, Catacutan, Ajayi, Sileshi, & Nieuwenhuis, 2015; Tittonell, 2014; Tittonell et al., 2010). Failing to acknowledge farmer's social views, the perception of their realities and strategies used to meet their food security and income generation goals, can lead to the development of farmer engagement traps.

The traps, originate from the mismatch between the whole household livelihood strategy, i.e., the management strategies farmers choose to pursue and believe are more likely to help them achieve their food security and income generation goals in detriment of the technical solutions "scientists" believe can improve their situation. Nevertheless, the management choices, are made independently of their technical efficiencies. This because, to most farmers, farming is not a technical practice and sustainability is about staying in the farm and being able to keep up with it because it became way of living (Vanclay, 2004). Therefore, agricultural interventions aiming at helping improve regional and whole household well-being, requires innovative solutions that are likely to capture farmers interest and willingness to participate without a radical change in their way of living and doing things.

3. Changing the *mind set* in agricultural research and development intervention

3.1. Farming households are complex adaptive enterprises and need to be treated as such

Farming households are highly dynamic and complex entities managed to meet food security and income generation goals through on farm and off farm activities. The management structure and internal dynamics of most SSA farming households are similar of those of a small family enterprise, which according to Mutunga and Gachunga (2013) are "...entities in which one or two persons are required to make all the critical management decisions such as finance, accounting, personnel, purchasing, processing or servicing, marketing and selling, without the aid of internal specialists and with specific knowledge in only one or two functional areas". Moreover, from an operational perspective, African farming households dynamic proprieties also match those of a complex adaptive system (Fuller & Moran, 2001). In such systems, the interaction between components of the system, e.g., covering daily homestead expenses, field management decisions, service provision and purchase, market linkages, information access and networking, creates management patterns that are characteristic of each household and their historical analysis can help understand the systems internal dynamic.

The isolation of individual parts of the systems for analysis or intervention without considering its part and interlinkages with the whole household enterprise functioning like it happens in most departmentalized agricultural interventions, does not reveal all the causal relations neither is capable to bring relevant and long term sustainable solutions. Therefore, treating farming households as complex and dynamic adaptive entities that are constantly adjusting to respond to internal and external changes is more in line with the challenges to transform Africa's smallholder farmers into a new productive and commercial category of farmers that can significantly feed the continent and the world. This new approach contrasts current simplistic and generalized definition of SSA farming households as mere subsistence entities whose primary goal is food production which is not the case depending on the

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