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Conceptualising farming systems for agricultural development research: Cases from Eastern and Southern Africa

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ABSTRACT

In the context of broad scale system changes (e.g. climate change) and the prioritisation of impact-at-scale development, there is a particular need for farming systems research (FSR) to improve our understanding of the links between systems at multiple scales. Drawing on three empirical case studies of large-scale agricultural interventions in eastern and southern Africa, we highlight problems that arise from conceiving and justifying interventions on the basis of the simple aggregation of farms into large collective systems. We review changes in the approach and concepts of FSR and point to the value of farming systems concepts that go beyond these aggregations, and find ways to capture the multi-level system dynamics that link on-farm decision making to broader political, social, and environmental changes. Recent attempts at more accurately conceptualising the domain of FSR, and drawing distinctions between 'farms', 'systems', and 'systems of farming', represent a useful contribution to such work.

1. Introduction

In the face of multifaceted uncertainties and the complex challenges of adaptation in Africa's agricultural sector, the use of a 'systems' approach is increasingly favoured across the interlinked epistemic communities of agricultural research and policy (Collinson, 1987; Darnhofer et al., 2012; Dixon, 2000). Such an approach recognises the contextual and dynamic nature of smallholder agricultural production and enables analysis of both biophysical and human processes that span temporal and spatial scales. Particularly since the 1980s, agricultural researchers have recognised the ways that interconnected and historically embedded social, economic, cultural, political and ecological processes interact to shape the dynamic contexts within which farmers make decisions (Collinson, 2000).

'Farming systems research' (FSR), the once proudly adopted label of a new and emerging discipline, was closely linked with developments in participatory research and the 'farmer first' movement (Chambers and Jiggins, 1987; Chambers et al., 1990), with obvious complementarities between the conceptualisation of multifaceted and localised systems, and the insights that might be gained from drawing on the knowledge of the farmers that experience this complexity first-hand. Whilst participation was once a central tenet of FSR, as the field has grown, approaches and applications within it have inevitably diversified. As a result, the FSR label itself is increasingly seen as a catch-all concept (Hart, 2000; Leon-Velargde et al., 2008; Noe and Alrøe, 2012; Sands, 1986), inclusive not only of investigations in to farm-scale processes, but of landscape scale modelling (Feola and Sattler, 2012) and economic analyses of data from surveys of large populations of farms of similar resources and activities (Dixon et al., 2001).

In response to this divergence, recent discussions over the appropriateness and application of the central 'farming systems' concept, and attempts to rethink it (Giller, 2013; Sumberg et al., 2013) are overdue. Dixon et al.'s (2001) recognition of individual 'farm systems' within broader 'farming systems', Giller's (2013) acknowledgement of the diversity, interactions, and interdependencies of farm systems (i.e. the heterogeneity of Dixon's 'farming system') and Sumberg et al.'s (2013) further distinction of a 'system of farming', to represent the systematic nature of on-farm decision-making, are all important contributions.

Drawing on these concepts, this paper presents a set of theoretically-grounded analyses of case studies of agricultural technology and research-based interventions in eastern and southern Africa, in which we make a distinction between the assumptions that underpin these large-scale system interventions and the farm system-level constraints and dynamics that determine the way that these interventions are experienced.

In reflecting on these cases and the recent history of development and disciplinary diversity within FSR, we recognise the value of a systems approach to understanding the political, social, environmental, and economic dynamics between, and beyond diverse and interacting farm systems. The implications of this are drawn

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out in the discussion, which suggests (in accordance with Giller) that a multi-level concept of farming systems, and (in accordance with Sumberg et al.) a focus on the systematic nature of decision-making, can offer important insights into, and even a means of re-negotiating, pathways of agricultural development.

2. Background

A conceptualisation of farming as a bounded system in which multifaceted and historically-embedded component parts – social, political, ecological, climatic, cultural, and economic processes – interact in dynamic ways, and a focus on these multiple system interactions, is at the core of an increasingly diverse field of agronomic research (Byerlee et al., 1982; Collinson, 1987, 2000; Darnhofer et al., 2010; Dewalt, 1985; Dixon, 2000; Gibbon, 2012; Maxwell, 1986; Quiroz et al., 2000; Ruthenberg, 1980). FSR became popularised as an approach to understanding the challenges of translating a green revolution of agricultural modernisation into the heterogeneous production environments of Africa and Latin America in the late 1970s (Collinson, 2000; Norman, 1995). The institutions of the Consultative Group on International Agricultural Research (CGIAR), primarily concerned with identifying barriers to the adoption of new technologies and techniques, began to acknowledge the ways in which context-specific access to agricultural inputs and output markets and the geographic distribution of poor soils acted to constraint the choices of smallholder farmers (Norman, 1978, 1995).

In collaboration with national agricultural research centres, particularly in southern and eastern Africa and Latin America, new research programmes within the CGIAR institutions emerged. In accordance with the participatory turn of the 1980s, these involved interdisciplinary teams of crop breeders and social scientists often combining economic analysis of farm/household surveys with participatory evaluations of new technologies (Cleveland and Soleri, 2002; Collinson, 2000; Norman, 1978, 1995). Sands (1986) explains that participatory research and being 'farmer-oriented' and 'on-farm research' were key components of FSR as it was 'originally conceived'. The late 1980s saw a broadening out of the participatory agenda, with tools such as Participatory Rural Appraisal (PRA) being advanced as a way of engaging with farmer-defined challenges and livelihood options, as opposed to restricting participation to a technical consultation over end products (as in participatory varietal selection) (Chambers, 1992; Chambers et al., 1990).

However, in spite of this movement, international agricultural research and development programmes, have struggled, in a similar way to that of national agricultural policy makers, to reconcile their recognition of heterogeneity and complex systems, with the reductionist inclinations that come with a focus on large scale, or even global priorities (Brooks, 2011; Dalrymple, 2008; Gardner and Lesser, 2003). Arguably the growing prioritisation of climate change agendas with agricultural research and development, and the dominance of global climate modelling in framing these agendas (Whitfield, 2014), has contributed to a movement away from farming systems being about local complexity towards a conceptualisation of, and focus on, regional/landscape scale systems.

Whilst the commitment to FSR within international (and African in particular) agronomy has strengthened since its 1970s origins, its application has significantly diversified. In its contemporary guise, FSR is no longer restricted to having an objective of addressing adoption constraints or even a focus on participatory and on-farm research, but it encompasses inquiry into the infrastructures, processes and/or functionality of farming, motivated by a range of objectives, utilising a range of methods, and this diversification is underpinned by a growing range of conceptualisations of the actors, boundaries, scales, and mechanisms of the 'farming system' (Collinson, 2000; Darnhofer et al., 2012; Sands, 1986).

A search term-based review of papers published in the journal *Agricultural Systems* since 2000[1] indicates that 192 papers are self-defined as farming systems research and, of these, 109 adopt a systems modelling approach, 94 involve some kind of econometric systems analysis, and 64 are based on participatory research. Modelling itself represents a diverse method of inquiry inclusive of the use of complex quantitative parameterisations of system components and interactions as well as more qualitative descriptors of systemic processes, and there has been a growth in the use of models as tools for participatory research, scenario development, and negotiated decision making (Whitfield and Reed, 2012). Within these studies, systems are defined in a variety of ways, with at least 14 papers explicitly addressing 'smallholder farming systems' and eight targeting 'maize, rice or wheat farming systems' specifically. A range of other systems terminology, often not explicitly distinguished from 'farming systems' is also evident, including 'cropping systems', 'innovation systems', 'agro-ecological systems', and more.

In interpreting complex systems, the disciplinary diversity of the field may represent a strength; however, the broadening array of system concepts that underpin these endeavours creates challenges for interpreting and integrating a growing body of evidence. Despite Deborah Sands's (1986) warning about the ambiguity associated with the concepts and approaches of FSR, critical engagement with the concept of farming systems has, until recently, inadequately addressed the divergence of 'farming systems' definitions (Giller, 2013), which has largely taken place under the radar of academic acknowledgement. Despite the fact that purposeful communities of FSR have formed (such as the International Farming Systems Association) they operate without a clearly defined concept of what constitutes a farming system and what FSR is and what it is not, with the result that they have little basis for cross referencing and the building of collective evidence.

Early definitions of farming systems, particularly those concerned with its application in relation to African smallholdings, emphasised a focus on the individual farm or household as the primary unit of study. Shaner et al. (1982) defined the farming system as:

> 'a unique and reasonably stable arrangement of farming enterprises that the household manages according to well-defined practices in response to physical, biological and socio-economic environments and in accordance with the household's goals, preferences and resources. These factors combine to influence output and production methods. More commonality is found within the system than between systems. The farming system is part of larger systems – e.g., the local community – and can be divided into subsystems – e.g., cropping systems. Central to the system is the farmer himself' (p. 37)

This corresponded closely with the participatory movement of the time, positioning farmers as the experts within their own farming system, which itself has an internal uniqueness that distinguishes it from the broader systems of the local community. This contrasts with a definition proposed by the FAO, almost two decades later in 2001, one which represents a significant and widely cited and adopted attempt to place new boundaries around the farming systems concept, which defined the system as:

> '…a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. Depending on the scale of the analysis, a farming system can encompass a

[1] As of May 2014.