ENHANCING POSITIVE IMPACT IN AGRICULTURAL RESEARCH FOR DEVELOPMENT: RETHINKING THE ROLE OF "AGRICULTURAL EXTENSION" AND RESEARCH

DRAFT Discussion Paper

ABSTRACT
TBC

1. INTRODUCTION

The aim of this paper is to help Agricultural Research for Development (AR4D) researchers and research organisations increase the positive impact of their research by thinking through some of the ways the research context is changing, how "agricultural extension" specifically has shifted, and what a rethink of agricultural extension suggests about and offers to agricultural research. The paper is informed by an extensive literature review, a series of workshops with ACIAR stakeholders, and 37 interviews with ACIAR researchers and experts in AR4D and extension. Five main sections make up the paper. Section 2 outlines the contemporary imperative for amplifying positive impacts from research in agriculture and the underpinning need to consider *how* impact is to be generated and amplified. Section 3 turns to the conventional tool for the application and diffusion of research in practice – agricultural extension (AE) – and outlines how its dominant linear approaches, and extension overall, has been discredited, dismantled and diversified over the last few decades in response to a suite of convergent pressures and substantive critiques. In response an Agricultural Innovation Systems lens is increasingly dominant. Section 4 highlights the implications of these same pressures for professional agricultural researchers, including many researchers' conventional reliance on now discredited, dissemination-based extension, broader challenges to institutionalised expertise and the radical democratisation of "research" that an Innovation Systems lens implies. Section 5 looks in more detail at how AE is being reconfigured and contested, including the revitalisation of some linear dissemination models and increasing awareness of the need for context-specific approaches to and impact evaluation of AE itself. It outlines how agricultural researchers might therefore think of and engage with AE, given their historic reliance on older forms of it in efforts to achieve research impact. Section 6 presents conclusions, arguing that - whatever it is called and whoever it is practiced by - AE remains an important concept, consideration and community for agricultural researchers striving to improve the impact of their work in the world. In particular, it argues that is crucial to understand that the forces transforming agricultural extension are also at work in agricultural research, even if less manifest to date. Examining AE thus points to the need for a larger conversation about challenges to the role, legitimacy and agility of formal agricultural research.

2. TOWARDS MORE POSITIVELY IMPACTFUL AGRICULTURAL RESEARCH

Impactful research is now a social and institutional imperative. This is especially the case in the agricultural sector which sits at the nexus of many of the 17 Sustainable Development Goals launched in 2015 by the United Nations to accelerate, target and improve development.

AR4D exemplifies the need to simultaneously fast-track and up-scale impacts. Yet agricultural research institutions and the broader innovation systems they are part of (discussed below) are still struggling to move beyond a "culture of promised impacts" to a "culture of impacts" (Leeuwis et al., 2018).

At the same time, agriculture and the research underpinning it are increasingly recognised as *already* generating a lot of impacts, including some that are increasingly not wanted or tolerated. The European Commission's Responsible Research and Innovation framework highlights the possibility of not just *failing* to generate research impacts, but of (inadvertently) generating negative ones. From this perspective, AR4D needs to not merely increase impacts, but to be increasingly *responsibly* impactful. This means addressing the tendency to turn a 'blind eye' towards research projects' negative environmental and sustainability implications (Weißhuhn et al., 2017) identified in agricultural research impact evaluations (p.36). Such oversights are becoming increasingly unacceptable as the collective effort required to urgently tackle climate change and resource scarcities becomes clearer. Agriculture has been in the background of many climate change discussions, but it is increasingly foregrounded due to the extent of its vulnerability to climate change and its greenhouse gas emissions, as well as a focus on the potential to re-absorb atmospheric carbon, and the increasing recognition of the implications for other resource users. The transitions required towards climate adaptive agriculture and more 'climate smart' overlap at least rhetorically, with broader efforts to transition society onto a sustainable, resilient basis.

The demand for research to help produce responsible, scalable impact begs the question of *how* such impact is to be achieved. Operationalising mitigation, for example, involves not only identifying technical emissions reduction options, but testing and embedding them in local places and processes, then scaling them up and out to achieve the accumulative impact necessary. For researchers seeking impact, this means that the knowledge, techniques and strategies they help produce need to be made useable, mobile, transferrable, visible and manageable at higher levels of organisation (Matschoss and Heiskanen, 2017). Conventionally, academic research has relied heavily on "dissemination" methods and agricultural research has particularly relied on a linear model of AE, which it has existed in a symbiotic relationship with as an information provider.

Until recently, these fundamental choices about the "how" or "process" aspects of research impact have remained unquestioned relative to a heavy focus on the substantive content of research. Yet, growing dissatisfaction with the research impacts being achieved (notably in international development), related demands for greater accountability around research investment, an emerging redefinition of innovation as not an idea, technique, 'object' or 'thing' but something that equates to actual on-ground change, and related debates about the value of AE, means that attention is increasingly focusing upon *how* researchers propose to achieve their intended impacts and contribute to broader societal goals.

In A4RD, use of formal research impact evaluation of the sort referred to by (Weißhuhn et al., 2017) above is one response to rising expectations around delivering improved research impacts. A second response is more process and theory oriented. It engages researchers, and/or the organisations and institutions they are involved in, in articulating theories of change and mapping expected impact pathways during research project design phases,

including the development of resultant indicators that are then used to track progress. The aim of such exercises is to try to anticipate, prioritise and monitor the causal relations that not only enable research findings to be produced, but lead to desirable outcomes. Moreover, it aims to produce insights into *how and why* an intervention has or has not worked in order to enhance its subsequent replicability and scalability (Maru et al., 2018).

In AR4D, the CGIAR has role modelled this approach. (Thornton et al., 2017) document their efforts to develop a theory of change for the CCAFS program, one that makes explicit the different stages involved (Figure 1). They emphasise that AR4D remains distinct from development *per se*, but like all applied research it goes beyond conventional 'basic' research to include a distinct focus on 'use of research outputs' and 'outcomes'. Worked examples demonstrate that the envisaged pathway to impact involves engaging with 'partners for messaging and engagement' and 'partners for impact', groups that once would have been referred to as extension providers or even science communicators. Emphasising the need to remain flexible in practice, the authors conclude that 'a theory of change approach appears to have considerable potential to achieve impacts that balance the drive to generate new knowledge in agricultural research with the priorities and urgency of the users and beneficiaries of research results, helping to bridge the gap between knowledge generation and development outcomes' (p.145).

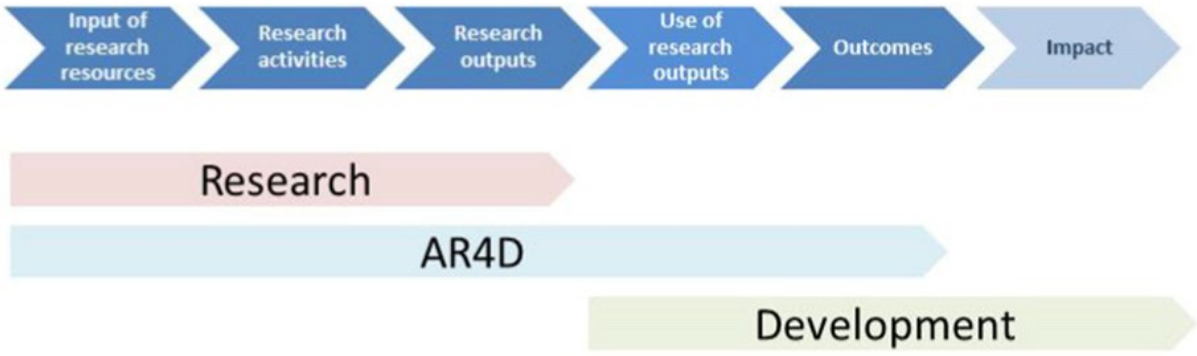

Figure 1. CGIAR CCAFS Theory of Change: 'A logical causal chain from research inputs to impact, and the domains of research, development, and agricultural research for development (AR4D). This is highly simplified from what may be a complex, iterative process.' (Thornton et al., 2017)

The representation in Figure 1 is a typical, simple and linear representation of the process steps that generate impacts from inputs. As the authors note, it is an over simplification of the way in which the messy and complex processes of successful AR4D, but enables the stages in the research to development process to be named and conceptualised. Other commentators agree with the need to "bridge the gap between knowledge generation and development outcomes", but contend that researchers cannot be held responsible for development outcomes, in part because 'impacts may occur at later moment, in different settings, in unanticipated manners, and/or over longer time horizons, and that such impact is contingent on many actors and factors outside the control of research organisations' ((Leeuwis et al., 2018) p.19). In this light, the linear (albeit flexible) approach of the sort proposed by (Thornton et al., 2017) is useful only to the extent that the situation involved is simple or complicated, whereas more complex, if not dynamic and chaotic, situations – of the sort that characterize some if not most AR4D projects – requires more systemic,

experimental, iterative, participatory approaches (see (Douthwaite and Hoffecker, 2017). These considerations of the fundamentally different situational analysis lead to support for two fundamentally contrasting approaches to research impact - the programmatic and linear as outlined by (Thornton et al., 2017) and the more systemic, experimental, iterative, participatory approaches (see (Douthwaite and Hoffecker, 2017) – which are central to many discussions about the modes and design of AR4D interventions.

Cutting across these debates about the types of approaches remains a shared acknowledgement about the importance of *the impact of agricultural research* – that is, agreement on the need to convert research into not just scientific and academic knowledge but lasting, positive outcomes "in the real world" of policy, production and practice. How to link research to practice is an issue that has troubled agricultural research periodically since it emerged in the eighteenth and nineteenth centuries and subsequently managed to gain a foothold in the authoritative world of professional research by emphasizing its theoretical not practical credentials (Rickards, 2006). It is also a concern that very early on generated a proposed solution, one that is conspicuously absent from most of the discussions referred to above. That solution is agricultural research's long-standing partner: "agricultural extension". According to the FAO:

> extension is defined as systems that should facilitate the access of farmers, their organisations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agri-business, and other relevant institutions; and assist them to develop their own technical, organisational and management skills and practices (in (Christoplos, 2010) p.3).

For researchers in agriculture and other fields (e.g. public health), extension has long been the key mechanism for disseminating the results of research and development projects. Sometimes now called 'advisory services' (as we discuss below) extension has also been a key policy instrument for government, both in the sense that much agricultural research has been directly or indirectly government-funded, and in the sense that large networks of extension agents have been a primary mechanism for engaging farmers on a wide range of policy initiatives and goals, whether voluntary or regulatory and whether focused on private and/or public goods. As unpacked further below, extension is also not only a separate occupation and role but an activity or practice that researchers themselves participate in (e.g. by producing reports, fact-sheets, policy briefs, field notes, demonstrations, videos and presentations), perhaps especially in cases where the professional extension sector is not available or appealing to partner with.

Despite many efforts at defining extension, its identity and importance remains a confused and contested question. Answers to the question help explain why AE *per se* is now barely mentioned in discussions about making agricultural research more responsibly impactful, even though efforts to facilitate access to knowledge and partners - referred to as extension functions in the FAO definition above – are arguably especially valuable in the context of the need to amplify and accelerate research impact. Although some commentators such as (Cristóvão et al., 2012) p.203 optimistically posit a 'comeback of extension', in practice AE is fading from view because of a combination of empirical, conceptual and political forces. But it is a mistake to interpret this as a loss of its functional significance for agricultural research.

Rather, the forces altering its visibility, flavor and form are also at work in agricultural research, its new manifestations and sites demand engagement, and it remains a functional need for researchers even if it is increasingly less clear who should do it or how.

Key Point 1: the functional roles of what was once known as 'agricultural extension' remain critically important to ensuring the impact of agricultural research, particularly given the increasing pressure to demonstrate impact. However, to ensure the efficacy of both research and extension requires reconceptualising their relationships and the underlying models, approaches and logics.

We turn now to look at the transformation of extension from a straight-forward knowledge and technology dissemination exercise to something more contested and complex.

3. THE RISE AND FALL OF AGRICULTURAL EXTENSION

3.1 The precarious role of formal extension

As indicated above, "agricultural extension" means many things to many people. To some people it refers specifically to state-based, often national-scale, formalised systems of extension agents charged with disseminating information and transferring new technologies to an entire (sub)population of farmers, often with the objective of increasing agricultural productivity. To others it refers to a field of knowledge and practice dedicated to supporting change and enabling learning within rural populations or other participants in the agro-food system. The Global Forum for Rural Advisory Services (GFRAS) defines extension – or as they call it, advisory services - from the practitioner's point of view:

> Rural advisory services are the different activities that provide information and services needed and demanded by farmers and other actors in rural settings to assist them in developing their technical, organisational and managerial skills and practices so as to improve their livelihoods and well-being. It recognises the diversity of actors in extension and advisory provision (public, private, civil society); much broadened support to rural communities (beyond technology and information sharing) including advice related to farm, organisational and business management; and facilitation and brokerage in rural development and value chains (Sulaiman and Davis 2012, p.2).

The above definition usefully points to some of the changes in the world of extension discussed below, including the shift to a demand-led model and web of interacting providers that it is vital for agricultural researchers to grasp. Leeuwis and Van de Ban's (2004) definition of extension, in contrast, underlines the normative intent of extension. As such it is particularly useful in thinking through how AE might relate to researchers seeking positive impacts:

> Extension is a series of embedded communicative interventions that are meant, among others, to develop and/or induce innovations which supposedly help to resolve (usually multi-actor) problematic situations.

Given that the number and range of problematic situations in the agricultural and rural sphere are not dissipating fast, Leeuwis and Van de Ban's definition of AE suggests that is of not only ongoing functional relevance, but growing relevance, even as it morphs in name and form. Yet, as we discuss below, it is not just AE but the whole innovation environment of agriculture that is changing, creating in itself a problematic situation for those invested in the old structures.

Originally AE emerged as a means for leading farmers and incipient agricultural scientists to tell other farmers – often in the form of pamphlets and demonstrations - about the results of their experiments with new techniques such as the use of new varieties or nitrogenous fertilisers. As agricultural science and economics was formalised and institutionalised over time, so too was much AE as its public outreach arm. Indeed, the professionalisation of agricultural science and economics arguably relied on establishing AE as a 'boundary organisation' - or more specifically, boundary occupation and institution - between agricultural science and farmers (Cash 2000). This was not simply to enable agricultural researchers to concentrate on their academic work, but to help stabilise the distance and relation between the worlds of academia and farming practice so that the former could remain connected but also independent and thus academically credible. In this sense, over the last two centuries AE has arguably helped 'co-produce' agricultural science and economics, not in the contemporary sense of being directly involved in the academic research, but in the Jasanoffian sense of helping establish a social order that has helped distinguish the two and thus demarcate recognisably independent, that is *scientific,* knowledge (*cf* (Jasanoff, 1996)). Until recently, the existence of such knowledge has in turn legitimated the need for and existence of AE as a subsequent dissemination mechanism. But, as discussed below, this synergistic relationship has been changing as the whole model has been critiqued and reformed.

To understand the changes underway, it is important to appreciate that, as well as stabilising and mediating the researcher-farmer boundary, AE has helped to stabilise and mediate the government-farmer relationship, at least in its historically dominant forms of state-based extension services. In this intermediary role between government and farmers extension theoretically provides a useful window from one world to the other, helping farmers understand government policy and direction, and helping governments understand the realities of farming and rural life. However, in practice extension has been rarely used by government as a source of information, ideas and concerns from rural communities. As a result, extension has frequently taken on the characteristic of a one-way transmittal of information from "top" to "bottom", informed to a greater or lesser extent by related findings from government-supported academic research. In such situations, extension agents are positioned as an arm of government, and the existence of extension services can be understood as helping to co-produce government by making locally manifest its distant presence and by enacting the governmental techniques of advising and assisting that have long been used by governments to help manage populations, territories and resources. Conversely, the intermediate position of extension agents between government and farmers means that they can be positioned as part of the rural community. While this can be useful in establishing legitimacy with rural actors, it means they have been susceptible to criticisms directed at farmers and rural populations, including those that imply a failure on the part of

extension to achieve the impacts desired by researchers, government or others, particularly in periods of dramatic change.

Such criticisms are one reason that formal AE services have been - since their heyday in the early and mid-twentieth century - discredited, delegitimised and dismantled by a number of forces. First, in many contexts the boundary between government and farmers has widened as the ideal model of governance has shifted from the paternalistic bureaucracy of the colonial and modernist eras to the superficially more "hands off" non-interventionism of the neoliberal era (Pussey 1991; (Sumberg and Thompson, 2012)). The reform or dismantling of state-based AE services has been pushed along in many contests by related objections to agricultural exceptionalism, a reframing of farming as simply another business, and a turn to alternative policy instruments such as voluntary industry codes for governing collective action issues in agriculture. Further, a focus on government efficiency and cost-benefit analyses documenting extension's apparent failure to provide a reasonable return on investment has supported arguments for reducing government administered services in many countries. Non-coincidentally, formal agricultural research has similarly experienced a reduction in government funding in many settings. Some production oriented R&D has been subsequently picked up by industry bodies in some countries (e.g. (Turner et al., 2017)) or, like in Australia, been transferred to commodity specific R&D corporations. In general, however, agricultural research declined from the 1970s, at least until the 2000s when agriculture and food security were once again reasserted as an international aid priority. In an aligned move in the 2010s a new generation of agri-tech and other agribusiness took off, helped in part by the way the Global Financial Crisis increased the relative appeal of farmland as an asset class (Ouma).

Second, formal AE services have declined because the boundary between researchers and farmers has been also destabilised by complaints. In this case, the complaints are not that the two spheres are *too close*, as in the case of extension and government, but that they are *not close enough*. Reflecting ongoing concerns about the return on investment that academic research provides to society – concerns that are clearly at work in the contemporary impact agenda – these passionate objections about formal, institutionalised research being too disconnected from the realities and needs of real world practice have led to a widespread embrace of more participatory research methods in which farmers are included within the research process to various degrees (discussed further below) (Sumberg and Thompson, 2012). This stepping of farmers towards researchers has been complemented more recently by efforts to step researchers towards farmers. Challenging researchers to do more than simply publish the results of their research in academic outlets, this move aims to motivate and equip researchers to more ably, reliably and efficiently shape positive practical outcomes. In other words, it encourages them to engage in what can, broadly speaking, be conceived as extension. Yet, not being extension professionals, and already busy with other demands, this arguably poses a serious challenge, as we discuss below.

In this double coming together into a more collaborative relationship of researchers and farmers, AE has arguably been squeezed out as a symptom of an older, rigid and hierarchical way of working. "Old school" AE services continue to exist, but they are often viewed as an anachronism, an embarrassing and likely ineffective system for researchers to associate with. As (Cristóvão et al., 2012) note, 'in the face of new approaches to innovation and extension', the 'top-down, linear model' 'is considered out-dated and obsolete' (p.210). In the language

of sociotechnical transitions theory – which is a popular framework for thinking through how society could move onto a more sustainable trajectory (see (Geels and Schot, 2007)) – AE is implicitly branded as part of the 'dominant regime' that needs to be swept aside by 'radical innovation' (eg (Maru et al., 2018)). The primary problem is that extension is considered by many to be an exemplar of the so-called linear "transfer of technology" approach that involves a metaphorical "injection" of externally-generated products into agricultural practice or rural communities, whether textual information, new technologies, or physical inputs, and helping them diffuse. Rejected as inappropriate and ineffective, this whole top-down intervention model has been widely disavowed, and with it, so has been extension to the extent it is interpreted as merely a diffusion or ToT mechanism. In particular, critical development scholars and activists have disputed the legitimacy and ethics of the top-down hierarchical approach. Building on decades of critique (eg…), the contemporary Food Sovereignty and agroecological movements build on decades of critique to argue that many formal researcher and extension efforts to educate farmers are not in rural communities' best interests and instead structurally perpetuate deeply problematic imperial, capitalist and often gendered power relationships.

Key Point 2: TBC

3.2 From extension to the broader agricultural innovation system

So how has AE changed in response? Three key responses are evident. The first is that AE has disappeared from view to a large degree, partly because of the dismantling of many extension services and partly because AE has spread to other actors throughout the agricultural and rural setting, gaining many alternative names and forms in the process. Because AE (in the broad sense of knowledge-intensive ways of helping rural communities deal with problematic situations) remains a functional need, an absence of formal AE represents a kind of failure and opportunity that other actors have stepped in to address. The result is a well recognised pluralisation and diversification of who is practicing AE. (Mango et al., 2015) for example point to proliferation of 'input suppliers, agro-processors, irrigation development, natural resources management and micro-financing […] programmes' directly involved in trying to improve smallholder agriculture in Africa (p.315), while (Ramirez et al., 2018) describe the new extension services being provided to smallholders by some but not all palm oil refinery firms in Colombia. Contributing to this new uneven distribution of AE providers is an emerging sense of extension as not something that only those with a specific job title or professional background can do, but a set of practices that virtually anyone can perform on an as-needs basis. This unbounding of extension from a designated role to a suite of recognisable practices resonates with social practice theory which contends that the world primarily consists of interlocking patterns of shared practices (regularized, purposeful activities) that individuals can become enrolled in (Shove et al., 2012) (eg cultivating, budgeting, publishing). Conceptualising practices as preceding social roles helps to make apparent the way that extension can be and is being *performed* by a dynamic range of actors, including in an *ad hoc* and strategic manner. It also points to the difficulty of not just containing AE to one social role but in it justifying the existence of a defined professional role that others recognise as a legitimate area of expertise. Conceptualising AE as a practice also crucially helps to underline the resilience of TOT AE practices, which despite the criticisms outlined above, continue unabated in some agricultural settings and indeed are emerging anew. Although often not

labelled as AE or even necessarily recognised by those involved as AE, TOT AE practices are being revived by new actors and agendas within the agricultural sphere as more get involved in trying to roll out, scale out and diffuse their vision of change. In particular, the reassertion of the food security agenda, the revolution in digital and other agricultural technologies, the influx of marketing and design thinking (which conventionally privileges an elite designer), and the need to engage farmers in climate change mitigation and adaptation are, among other things, stimulating a new wave of ambitious programs for improving agriculture via various dissemination, diffusion and scaling of innovation efforts. As (Christoplos, 2012) notes, linear agricultural extension 'is frequently assumed to be a major potential 'implementing partner' in climate adaptation efforts' despite being 'often portrayed as a worst-case example of the obstacles encountered in changing the focus of a path dependent bureaucracy' (p.189).

The second response to criticisms of AE is a rebooting of formal AE to vastly improve its practices, organisation and status. There are a few elements to this. One is a long-standing effort to move away from (just) basic TOT practices such as producing fact sheets to more participatory methods such as facilitating women farmer groups in order to try to generate more sustained, effective engagement and reach beyond dominant local actors. Indeed, since the 1970s a plethora of interesting participatory and systems-oriented alternatives to TOT have emerged, focused in various ways on joint, experiential learning, facilitation, group-based methods and shared problem-solving (Birner et al., 2009; Sumberg and Thompson, 2012; Global-Forum-for-Rural-Advisory-Services, 2012). Common to many of these approaches is an awareness that technological innovation is not sufficient or even necessary to achieve transformational impact in many settings, but that social innovation and things such as 'learning competence' are needed, as (Pant, 2014) documents for Nepal and India. The matter of competence is a further aspect of rebooting AE, with a renewed internal focus on skilling up AE agents through, for example, the comprehensive professional development resources produced by GFRAS's New Extensionist program. The latter represents a further way the field is being revived, which is by trying to increase its international and regional coordination through a series of networks, related conferences and professional resources.

Consistent with both a diversification of actors practicing AE and the enhanced interactions of formal AE agents is the third, dominant response to criticisms of AE, which is that it has been absorbed into a higher scale systems perspective and associated initiatives designed to rethink and reinvigorate innovation generation in the agricultural and rural sectors. Of particular influence is the concept of Agricultural Innovation Systems (AIS), defined originally by (Hall et al., 2003) as 'systems of reflexive, learning interactions and their location in, and relationship with, their institutional context' (p.213) in work aimed at broadening ideas of research impact within CGIAR. The uniqueness of the AIS approach is that it focuses on 'the complex interactions between a multitude of players and sub-systems that characterize innovation' (Klerkx et al., 2012) (p.464). The rise of AIS thinking reflects various currents. Its origins in World Bank work suggest that it reflects the latest wave of efforts to make agricultural enterprises (and development agencies) more business-like, in keeping with the broader neoliberal agenda of diffusing private sector ways of working throughout society. In contrast to older, ongoing efforts to use lessons from business management to make farmers more responsible risk managers, this wave of business insights is focused on how innovation can be generated more effectively and how entrepreneurism can be fostered. The generally

Small-Medium Enterprise character of agricultural businesses, their often resourceful and opportunistic way of working, and their relative isolation from broader networks makes agriculture ripe for the importation of such ideas. Centred on the concept of the innovation system, this approach envisages and reports on an apparent shift in how the agricultural sector, including its associated research and knowledge services, is structured and generates innovation (Pound and Essegbey, 2007). It positions formal research within the broader environment or "ecosystem" of institutional actors, recasting R&D as a recursive, negotiated process. 'a co-evolutionary process, resulting from alignment of technical, social, institutional and organizational dimensions' (Kilelu et al 2013).

In an innovation system lens, the 'innovation intermediary' role (*cf* (Howells, 2006) that extension demonstrates is *amplified* in importance. Somewhat ironically, though, although Faure et al (2016) note that innovation systems are a broader context for extension and advisory services, their status as a form of intermediation is *diminished* because of the perceived narrowness and 'micro' scale of their one-to-one connections, especially if those connections are characterised by a top-down power dynamic. In the systems perspective, innovation is instead understood as an emergent property or collective achievement of a distributed many-to-many network of multidirectional vertical and horizontal relations between diverse actors. As (Klerkx and Leeuwis, 2009) explain:

> … traditionally, agriculture has been familiar with an intermediary layer between research and end-users (farmers) known as 'agricultural extension'. This intermediary used to be publicly financed and had the goal of bridging the gap between agricultural science and farming practice. However, agricultural extension became increasingly criticized as being part of a linear science-push innovation system. Recent policy changes such as privatization have caused the disappearance of this intermediary layer as a homogeneous entity. This implies that the situation in the agricultural sector with regard to acquiring knowledge and technology now resembles the situation of non-agricultural (e.g. industrial, service, retail) SMEs p.853)

The appeal of innovation systems thinking stems from various factors. First, it resonates with longer-standing calls for systems thinking in agriculture and natural resource management, including Farming Systems Research, Agricultural Knowledge and Information Systems (AKIS), and social-ecological systems perspectives ((Pant and Hambly-Odame, 2009) e.g. (Ison and Russell, 2000)). As discussed further below, these perspectives have long argued that linear approaches to innovation are based on a misrecognition of the real world, an inaccurate and misguided over-simplification of how things actually work, including the role of "end users" as innovating with rather than just "adopting" technologies (e.g. (Douthwaite et al., 2001)). The proposition of AKIS by (Röling, 1990) is especially significant as it added to intellectual claims about how the world operates with: (1) a more normative assertion about how the world *should* be managed (2) an explicit interest in the role of research and extension as part of farmers' worlds and (3) a call to better link the different parts so that researchers, extension agents and farmers work more closely. Although it uses the term system, the focus in AKIS is on 'the coordination among actors with different perspectives of who are part of a 'human activity system' (Röling 1992), with the systems concept used 'as a strategy to make people think of them-selves as being part of a system, with the view of enhancing coordination' (Klerkx et al., 2012) p.463. It continues to be used as a source of insights in AR4D, with (Mittal

et al., 2018) for example using it to identify that government AE agents in India are well networked among themselves but poorly connected to non-government actors. Although AKIS and AIS arose in parallel (Klerkx et al., 2012), AKIS is increasingly being superseded by the AIS approach that builds on network analysis with deeper systems-thinking, moving beyond a hard systems focus on describing components and coordination to thinking of emergent properties.

Second, innovation systems thinking marries the enduring language and appeal of a business and technology focus to a contemporary appreciation of the importance of relationships, soft skills, broad systems, and social learning (ref). It thus satisfies many parties and performs a useful role as a shared focus (a shared discursive or 'boundary object' – e.g. (Ayre et al., 2016)). Third, the cross-scalar scope of an innovation systems lens aligns with more recent theoretical lenses such as the Sustainability Transitions Management approach mentioned above in that both take into consideration the institutional setting, socio-political factors and the need to embed changes for sustained progress (ref). Fourth, an innovation systems approach works with neoliberal and progressive efforts to dismantle supply-driven knowledge models, notably those that automatically prioritise government and university-based research. Along with extension, these actors and organisations lose their privileged status as knowledge providers within the model of demand-led, distributed, democratic innovation generation. As discussed in the next section, this move is part of a broader effort to get elites and experts to step back and make room for new voices, ideas and initiatives in tackling society's shared challenges. As (Klerkx and Leeuwis, 2008) explain, in the innovation systems approach that has replaced 'the linear view of innovation (i.e., agricultural R%D generates technologies that agricultural extension transfers to agricultural producers for adoption)', various actors 'are seen as relevant to agricultural innovation, including agricultural entrepreneurs, researchers, consultants, policy makers, supplier and processing industries, retail, customers' (p.365).

Positioned between the three responses outlined above are numerous hybrid approaches. An example is the Integrated Agricultural Research *For* Development (IAR4D) introduced by the CGIAR's Sub-Saharan Africa Challenge Programme in 2005, which combines the idea of innovation systems with an explicitly participatory, decentralised approach. Prompting the development of the approach was deep frustration with the linearity and narrowness of the conventional Agricultural Research and Development model that was seen as responsible for the ongoing failure of agricultural research to improve smallholder livelihoods and food security in sub-Saharan Africa. Instead of 'a narrow focus on supply-driven research by scientists and its transfer to farmers through extension agents', IAR4D pursues 'impact through implementing innovation platforms that engage multiple actors along the commodity value chain in seeking to innovate solutions to technological, institutional and infrastructural constraints in the agricultural system' (Maru et al., 2018) p.310). Evaluations to date suggest that, while the results in any one location depend on antecedent conditions (Pamuk et al., 2014) including existing local relations of the sort that critical development scholars highlight as vital considerations, these sorts of more networked, multidisciplinary, collaborative problem solving approaches (figure 2) are generally delivering positive impacts (Mango et al., 2015; Siziba et al., 2013). A recent review of nine innovation platform projects in West Africa concludes that they have demonstrably improved farmer technical knowledge and productivity, strengthened market linkages and value chains, and plugged some

important institutional gaps, all primarily by fostering social capital (Davies et al., 2018). Relative to a reliance on a single agricultural extension agent, the networks increase farmers' resilience by multiplying and diversifying their relationships with other partners, creating 'complex social networks with high density and degree of distribution' that open up new options (Ngaboyisonga et al., 2017) p.85. Although it is not clear how evenly participation in such networks is distributed across local populations, results in some locations suggest that network participation assists female farmers in accumulating productive assets (Ayanwale et al., 2017), fulfilling a goal of the liberal gender agenda.

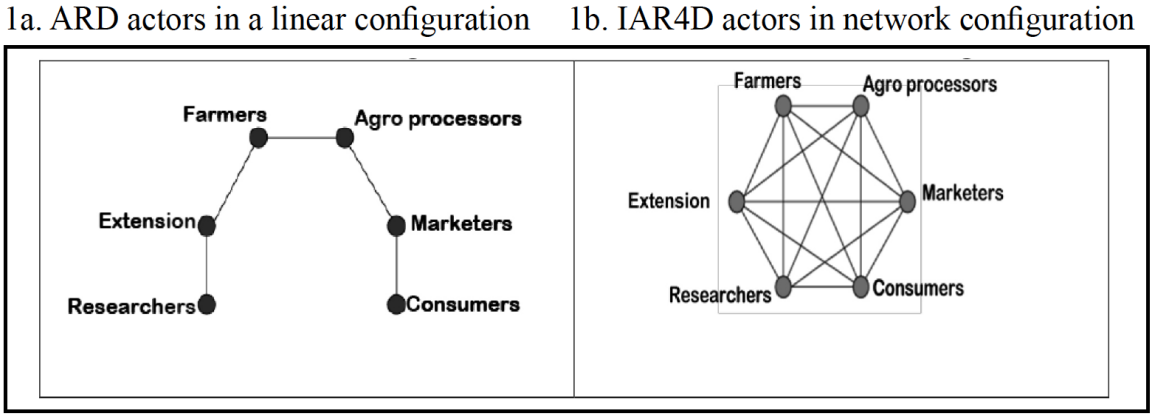

Figure 2. A contrast between ARD and IAR4D. From Mango et al. (2015: 110) [originally from the Sub-Saharan Africa Challenge Programme Mid-term Review, 2009]

Overall, the standardised, vertical "pipeline" model of innovation diffusion from recognised knowledge providers to knowledge users has morphed in multiple ways into more progressive, collaborative, problem-solving oriented approaches that are increasingly conceived as participatory local-scale processes nested within a larger web of horizontal and vertical innovation generating relations. Reflective of this shift, as well as the research impact agenda, is a change in evaluations of the performance and impact of extension from a focus on extension services to a focus on AIS, or at least 'Extension and Advisory Services' (EAS) conceived within AIS (eg (Faure et al., 2016)).

A crucial question for AR4D is how researchers and institutions fit in to AIS. As (Faure et al., 2016) note, the concept of AIS 'was developed to more inclusively take into account the range of actors and networks contributing to innovation *beyond the usual "knowledge infrastructure" (research, education and extension)'* (p.4, italics added). AIS were explicitly designed to supersede the idea of Agricultural Knowledge and Information Systems in which researchers were placed in a more recursive relationship with extension and farmers but remained clearly demarcated and located. Although the normative and structural reconfiguration of innovation actors and processes within AIS still provides space for formal research, exactly where it - as part of the 'usual "knowledge infrastructure"' – other than *not* simply at the start of an innovation pipeline is an open question that AR4D is yet to fully grapple with.

Key Point 3: AR4D needs to grapple with the question of how researchers and institutions fit within Agricultural Innovation Systems.. Although structural reconfiguration of innovation actors and processes within AIS provides space for formal research, exactly where and how it fits into the "knowledge infrastructure" deserves serious consideration.

4. DOING AGRICULTURAL RESEARCH IN THE NEW WORLD OF INNOVATION SYSTEMS

Like extension, AR4D has also been strongly encouraged to become more participatory, collaborative and solutions oriented. Some of this has been on ethical grounds, including the need to address inequities in decision making power between not only researchers and local farmers, but in terms of the subset of rural residents that researchers engage with, which has typically been characterised by a strong bias towards males and "leading farmers" already aligned with the development trajectory the research is encouraging. Some of the push for participatory approaches has been more instrumental, driven by the same desire for impactful research mentioned above, and related efforts to make research more effective and cost-efficient. Even in the diffusion of innovations literature, engaging "end users" of innovations early in the research and design process is increasingly recognised as good practice, tempering the typical research-development-adoption-diffusion pipeline model. In these ways, how AR4D is practiced has started to change dramatically. Simultaneously, there has been a parallel but related push for research projects to adopt a more systems thinking perspective. This encourages researchers to look beyond the lab, field and technical considerations, to the dynamic components and relationships that underpin the whole farm, the farm household, the rural community, the broader landscape, value chains and the wider socio-ecological system.

For agricultural researchers, the shift to innovation systems can be seen as a continuation of these earlier paradigm shifts in AR4D, encompassing - as innovations systems do - a more inclusive, pragmatic and holistic ethos. Yet, the innovations system lens does not only challenge the way research projects are conducted, the utility of their outcomes or the scope of their content. It also fundamentally challenges the structural role and identity of research and extension as distinct and definable processes. Innovation systems are designed to increase real-world innovation and demonstrate impact; they are not designed to help formal agricultural research or extension to demonstrate such impact. Indeed, they have no allegiance to the ongoing existence of formal research and extension as separate nodes. They instead proliferate alternatives nodes as loci of innovations and reframe research and extension as practices that all actors can perform. Innovation is understood to emerge not from a research 'well' but endogenously from the system as a whole, whether operating at a local, national or sectoral scale. It is the identity of the system that is most important, not the inclusion of a particular pre-determined node of activity that may or may not be relevant as a driver of innovation. Although many "systems" approaches in AR4D are in actuality just about networks (connecting existing nodes), a more thoroughly systemic approach does not presume the prior existence of particular nodes but instead understands them as relational and emergent; that is, as outcomes of specific relations at a specific time. As discussed below, this means that in designing an innovation system, the "source" of knowledge is not only blended with "use" of knowledge, but no particular, original sources need to exist at the outset. In other words, formal research of the sort done in AR4D institutions is not a

prerequisite for innovation systems, but rather one *possible* kind of resource that can go into the mix, from which point it must be open to not only being more participatory etc, but evolving its original identity and function as a natural outcome of ongoing processes of interactive innovation.

A seemingly mundane but quite transformational challenge that this poses for research is that it unsettles the now-dominant organisational device used to manage research: "the project". Within an innovation system, the future- and action-orientation of projects makes them, at one level, an exceedingly useful managerial tool. But the new openness to exchange, dynamism, learning and opportunism plus attention to the necessity of relationship building and institutional embedding that an innovation systems approach involves, strains the conventional idea of a project as a demarcated activity with a clear beginning, middle and end that allows for rational monitoring, evaluation and impact attribution. Any one project is likely to be unsettled by the proliferation, evolution and adaptation of not only its own activities, effects and relations, but those of related initiatives. Projects can be too rigid a classification for situations that arguably demand participatory and adaptive management of even end goals (Douthwaite et al., 2017). This problematisation of the project as a managerial device resonates with criticisms that project-based approaches to achieving research impact only achieve 'islands of success' (Scoones, 1997). The resultant push to scale impacts - 'one of the greatest challenges facing the development community' (CGIAR, 2016) (p.24) - is encouraging fresh interest in the messiness of research and the long-term, extra-project nature of building the relationships and connections necessary to generate effective innovation systems (Wigboldus et al., 2016; Douthwaite et al., 2017).

Adding to the destabilisation of the identity and structural position of formal agricultural research is the pluralisation of funding sources and agendas underpinning particular research projects and the diversification of actors engaged in "research", albeit of a type that may not be immediately recognisable to professional or academic researchers. Like extension, research is being recast as a practice. The learning ethos central to innovation systems and adaptive management means that action research is especially recognised as a useful strategy by diverse actors, whether or not they are invited by "a researcher" to participate in a formal research project (Charles and Neil, 2007). Those accustomed to conducting formal research projects need to adapt to this new research landscape in which claims to research *per se* are not unique and the added value brought by academic research practices is not always apparent.

Research in the more generic sense of pursuing questions and "seeking answers" also competes for attention with formal research projects to the extent that "knowledge users" such as farmers have a growing plethora of information sources available. As (Cristóvão et al., 2012) note, farmers as a group are, like others, increasingly autonomous learners. Access to the internet means not only being able to access a particular research project's app or webpage, but all the competing sources of information and advice, often ones that are accessible far before a research project reaches completion. In this global "marketplace of ideas", expert academic discourse is not only less prominent, but actively de-valued by the rise of populist knowledge politics. As (Cash et al., 2003) observed 15 years ago, professional researchers cannot assume their input is valued; they need to prove the credibility, legitimacy and relevance of their knowledge to a particular audience at a particular point in time. An

upshot of this is that research communication is not just about clarity or reach, but about engagement, perceptions, appeal and the politics of trust and credibility. Professional researchers need to build relationships and linkages with others not just to improve the relevance and utility of their research results but to ensure they are understood as having a right to have a say at all.

These questions of legitimacy are increasingly important in a developing world context where knowledge politics tends to be especially intense (Clark et al., 2011b), partly because of the abundance of groups practicing extension to smallholders. In such contexts, boundary work involves more than translating knowledge or matching demand and supply; it is a 'negotiation support process engaged in creating usable knowledge *and the social order* that creates and uses that knowledge' (Clark et al., 2011a) p.7, italics added). At one level, this is about negotiating with different interests at work in a given context, including other development initiatives, and recognising that it may be 'necessary to enter into alliances with other interventions' (Blundo Canto et al., 2018) p.31. More broadly, negotiating the social order around innovation generation involves distinguishing, positioning and justifying the role of professional or academic research in collectively producing, testing and endorsing various innovations, even within a single project, as well as the relationship between and role of different disciplines. It involves negotiating how research and extension practices contribute to innovation at different levels and scales and how these practices are distributed between and are jointly performed by different actors. One outcome may be that professional researchers seek out and engage 'formal country extension schemes' as (Pearce, 2010) suggests has been successfully done by ACIAR projects in the past. It might be to engage extension agents with others in research, including deliberate 'outreach strategy research' (Nhuan et al., 2017), which may in turn generate new approaches to outreach as part of the ongoing development of a loose community based innovation system of the sort that IAR4D approaches arguably illustrate. Or it might be recognising the array of formal and informal initiatives already underway in a given context and working not to insert a new research project *per se*, at least initially, but to embed researchers in existing contexts to study and contribute in an emergent way to the innovation processes at work. To the extent this involves linking, fostering and leveraging others' efforts (including across geographic boundaries and scales), many of the practices involved may be better characterised as extension than research *per se.* This underlines the need to retain flexible role identities in innovation systems approaches, recognising that 'rather than forcing fixed labels and narrow functions' to different groups… more holistic approaches can provide more fruitful avenues' ((Ramirez et al., 2018) p.1331).

Valuable insights into this new way of working are available in the agroecological literature, which has traditionally occupied only a marginal position in AR4D discussions partly because of its alternative, but now highly relevant, ways of working. Indicative of the potentially rich intersections between AIS and agroecological approaches that are yet to be explored (Foran et al., 2014), agroecology has the advantage of a long history of sitting at the intersection of science, practice and social change. Those involved are well versed in 'negotiating the boundary between the academy and community' (Giles and Giles, 2012) and frequently move across the spectrum of practitioner/practitioner-as-researcher/researcher-as-practitioner/researcher (Friedland, 2010). Their experiences thus overlap with and offer lessons for researchers working in CGIAR, who (Leeuwis et al., 2018) note often 'experience

a tension between working towards 'scientific output' and working towards 'development output' (p.18). Agroecological researcher/practitioners are also highly attuned to the politics of knowledge, the value of openly normative goals and the need to attend closely to the realworld impacts of research over time. In this the agroecological approach helps address what (Klerkx et al., 2012) argue is a weakness of some AIS thinking, which is that it tends to gloss over the fact 'that the goals, interests and perspectives of interdependent actors are likely to diverge and be conflictive' (p.464) and the actual value of any innovation trajectory needs to be debated, not presumed from the start. At its best, AIS approaches emphasise the social, policy, and governance context of research and how it enables, often unwittingly, some improvement efforts and impacts more than others (Sumberg and Thompson, 2012).

An AR4D approach that overlaps explicitly with agroecology is the Landcare movement. Bringing together many of the shifts and challenges referred to in preceding sections, Landcare offers important lessons for how research and extension is beginning to be reworked in an AIS approach to achieving on-ground impact. Landcare is referred to by the Australian Framework for Landcare 2010-20 as an ethic, movement and model. As such it exemplifies an ethically responsible, action-oriented, participatory and cross-scale approach to social and technical innovation of the sort that multiple more recent agendas are calling for. Although it has various aspects and objectives, reflecting in part its multiple origins and international diversity (Catacutan et al., 2009), at base Landcare is about bringing together members of local and regional communities to collectively manage the land in an environmentally sustainable manner. It is celebrated as one of the forerunners of the post-TOT approach to agricultural extension, being centred as it is on voluntary groups, developing social capital and addressing shared, practical ecological and systemic challenges (not just agricultural productivity) (e.g. (Cramb, 2005; Cramb, 2006) on the Philippines). It may involve formal research and conventional 'technical' approaches to extension but only on an as-needed, strategic basis. Far more fundamental is the careful facilitation of Landcare groups. Although such facilitation can look 'anything but strategic' to casual observers (Campbell, 1995a) p.15, it demands sophisticated multifaceted skills in 'fomenting synergy' (Campbell, 2000). Increasingly, this includes managing the bureaucratic, economic and political environment, and engaging with higher level organisations and transnational networks. By working among land managers locally, often at the landscape scale, and up and across vertical structures, Landcare has managed to achieve a significant degree of scaling out and up. These achievements however have not been even, easy or permanent. At every level of Landcare - from local groups to the global scale - the inherent politics of knowledge and action is apparent, including pushback from the "dominant regime" and challenges posed by shifting government agendas (Campbell, 1995a; Robins, 2018; Tennent and Lockie, 2013; Cramb and Culasero, 2003). The latter has meant that the 'model' of Landcare has proven less robust than its ethic and social movement (Robins, 2018). There is an opportunity to rethink Landcare through an AIS lens, noting how it already demonstrates many characteristics of a functional innovation system. Connecting AIS and Landcare could, in turn, be used to help link the insights and lessons from Landcare into the main body of AR4D. Key to this is helping AR4D 'move beyond the myopic linearity of conceptualizing "research" and "extension" as distinct activities' (Campbell, 1995b) p.127.

Key Point 4 ……. TBC!

5. CONCLUSION

TBC

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