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This Special Issue focuses specifically on contributions on how the private sector, through the design and organization of partnerships that strive to move beyond 'business as usual', contributes - or fails or struggles to contribute - to transform agricultural and rural development towards the achievement of the SDGs. The contributions to this Special Issue are diverse in terms of geographical location (South East Asia, Europe and Africa, Benin, Ghana, Kenya and Rwanda) but also in terms of themes: value chains, knowledge management strategies, research processes, knowledge brokering, institutional spaces, knowledge networks and governance. A number of the contributions to the Special Issue provide examples of how collabration between the private sector and other actors, including marginalized women and small farmers, can be facilitated and give value to research processes and in terms of scaling up innovations. The contributions attracted and co-developed with the authors include analytical frameworks, typologies of partnerships, benchmarking practices and mapping of the intellectual assets of the private sector. The contributions do not lead to the immediate conclusion that the private sector is a 'magic bullet' in global development. Instead, they lead to the conclusion that the private sector does have a role to play but that this role requires facilitation and brokerage to be effective.

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EDITORIAL

The unusual suspect? The private sector in knowledge partnerships for agricultural and rural development

Rationale

In September 2015, the member states of the United Nations (UN) General Assembly agreed on Agenda 2030 and the Sustainable Development Goals (SDGs), a transformational programme to address the problems facing the global community, including poverty, gender inequality, and climate change (UN, 2015). It is widely considered that to achieve this ambitious agenda, global efforts will need to involve and harness the private sector. Against this background, the private sector is receiving increasing prominence in agricultural and rural development. Not only small businesses in the global South but also multinationals are being courted by bilateral and multilateral development agencies, like the US Agency for International Development (USAID, 2020) and the UN itself (UN Joint Inspection Unit, 2017), as a way to increase the impact of public funds. The CGIAR, identifying itself as 'the world's largest global agricultural innovation network'[i] considers partnering with the private sector as a strategic opportunity for impact at scale and to contribute to the SDGs (CGIAR, 2020). This emphasis is part of a 'rapidly deepening normative discourse that positions the private sector as an active development agent' (McEwan et al, 2017: 29), potentially seeing the private sector as the 'magic bullet' to solve development problems. In this Special Issue, we recognise this growing normative discourse – also discussed by Marie Hur and Liora Stührenberg's paper on governance of food and nutrition security policy in this issue – but, through research, we also want to examine critically what the private sector has to offer global development in terms of knowledge management. Against this background, appropriate efforts and mechanisms to work in concert with private enterprise are crucial.

A widely shared view across policy, academia and civil society considers that societal transformations towards more sustainable and just socio-ecological systems require a different way of thinking of and engaging with, the private sector (Scheyvens et al. 2016). This means that the global development community, including both policymakers, non-governmental organizations (NGOs) and scientists need to reflect on how they work and partner with private actors – including small and medium enterprises (SMEs), multinational companies, financial institutions, and foundations among others – to move beyond 'business as usual' (Spangenberg, 2013). The need for transformation for achieving the SDGs is crucial in agri-food systems (Klerkx & Begemann 2020), although multiple pathways for engaging a diverse range of stakeholders – including the private sector – exist and are contested (Cummings et al. 2019a; Dentoni et al. 2017).

Knowledge is viewed through its transformative power within, in particular, contexts of extreme poverty where, for example it has been analyzed as requiring boundary work to facilitate its exchange (Qureshi et al, 2018). Although development discourse often sees knowledge as an antidote to poverty, processes of creation and exchange of knowledge for development needed to be examined. For example, in the case of grassroot development, it is shown that different types of knowledge processes are being supported by different social capital dynamics at the community level (Cummings et al, 2019b). Taking informed and commonly understood decisions on how to transform partnerships towards the achievement of the SDGs requires deep reflection and experimentation on how knowledge is managed and co-created among multiple stakeholders (van Ewijk and Ros-Tonen 2021), including for-profit actors (Dentoni et al. 2018). In spite of the need of transforming private sector engagements in international development, the role of the private sector in knowledge brokering and knowledge partnerships has not received much attention from researchers (Cummings et al, 2020). Empirical evidence shows that while the private sector's roles in knowledge partnerships and brokering for the SDGs are versatile, companies' resource investments focus primarily in supporting knowledge uptake in ways that are largely driven by self-interest (Kiwanuka et al, in this issue). This is a problem because the private sector, as well as their public and not-for-profit partners, might miss the chance to co-develop knowledge management systems (Carrillo et al. 2009) that are truly effective in achieving the SDGs (Caiado et al. 2018).

Given this knowledge gap, this Special Issue focuses specifically on contributions on how the private sector, through the design and organization of partnerships that strive to move beyond 'business as usual', contributes - or fails or struggles to contribute - to transform agricultural and rural development towards the achievement of the SDGs. The contributions to this Special Issue are diverse in terms of geographical location (South East Asia, Europe and Africa, Benin, Ghana, Kenya and Rwanda) but also in terms of themes: value chains, knowledge management strategies, research processes, knowledge brokering, institutional spaces, knowledge networks and governance. A number of the contributions to the Special Issue provide examples of how collabration between the private sector and other actors, including marginalized women and small farmers, can be facilitated and give value to research processes and in terms of scaling up innovations. As the next section illustrates, the contributions that we attracted and co-developed with the authors include analytical frameworks, typologies of partnerships, benchmarking practices and mapping of the intellectual assets of the private sector. The contributions do not lead to the immediate conclusion that the private sector is a 'magic bullet' in global development. Instead, they lead to the conclusion that the private sector does have a role to play but that this role requires facilitation and brokerage to be effective.

The final contribution has not been accepted as part of the Special Issue as it relates to the knowledge management implications of the coronavirus. However, there is no doubt that the

pandemic itself is a game changer, impacting on the relationship between all actors, knowledge management and global development.

Papers

The first paper, 'Can the private sector help deliver improved technology to cassava smallholders in South East Asia?' (Jonathan Newby, Dominic Smith, Rob Cramb, Cu Thi Le Thuy, Laothao Youabee, Chea Sareth, Sophearith Sok, Chanphasouk Tanthaphone, Wani Hadiutomo, Lê Việt Dũng, Nguyễn Văn Nam) argues that despite successful public sector research conducted with farmers over several decades, translating these research outputs into widespread adoption by farmers has had mixed success. To consider whether private sector actors in the cassava industry can have a greater role in knowledge transfer, the authors have developed a framework based on characteristics of the cassava value chain. This framework is used to analyse six contrasting case studies from four South East Asian countries, ranging from underdeveloped value chains around small-scale processing of animal feed to highly-commercialized international value chains for starch. Analysis indicates that the private sector is not a panacea for generating research impacts at scale. In all cases, they found that support from a knowledge broker, such as a public sector or non-governmental actor with the capacity to work with farmers, is also required.

Next, 'Knowledge management unlocks market systems and empowers women farmers in Bangladesh' (Albaab Ur-Rahman, Emily Janoch, Prabodh Devkota) explains how CARE Bangladesh engaged with the private sector to create gender-sensitive inclusive business solutions that benefit both market actors and women from marginalized communities in agriculture. CARE worked collaboratively with women producers and the private sector to come to solutions that would not have been possible from one perspective alone. The approach is exemplified in two case studies which focus on fresh dairy market systems and financial inclusion of women smallholder farmers respectively. The strategic architecture of knowledge management was employed to bring these actors together with a shared vision of mutual benefit to develop market-based solutions, manage private sector partnerships and help communities overcome gender and economic barriers.

Third, 'The private sector in knowledge processes and partnerships for food and nutrition security in the Global South: a case study from the Dutch Food and Business Applied Research Fund programme' (Frejus Thoto, Mawuna Donald Houessou, Corinne Lamain, Rodrigue C. Gbedomon) considers that for-profit actors can bring value to research processes and knowledge development. However, the collaborations come with challenges related to goals and interests, implementation approach, and marketing strategies. The outcomes of such collaborations may be mixed and, in some cases, lead to results that do not include the most food insecure. Partnerships that include the private sector should be cognizant of the possible challenges and proactively define approaches that leverage the private sector to add value to food and nutrition security outcomes.

The fourth paper, 'The private sector as the "unusual suspect" in knowledge brokering for international sustainable development: a critical review' (Suzanne Kiwanuka, Sarah Cummings, Barbara Regeer) draws on Glegg and Hoens' (2016) meta-framework of knowledge brokering to analyse the role of the private sector in knowledge brokering in Europe and Africa. It establishes that the private sector's roles are versatile, extending beyond connecting research evidence to potential users, to connecting researchers to funding opportunities and to other researchers, and to hosting platforms. The private sector actively invests resources to facilitate knowledge uptake, although this is to a large extent driven by self-interest. Perceived self-interests remain a barrier to knowledge brokering with the private sector not always being seen as a trusted partner.

Next, 'Multi-stakeholder dialogue space on farmer-led irrigation development in Ghana: an instrument driving systemic change with private sector initiatives' (Thai Minh, Olufunke Cofie, Nicole Lefore and Petra Schmitter) explores how multi-stakeholder dialogues can capitalize on and trickle systemic change through private sector involvement. Analysis from the farmer-led irrigation development multi-stakeholder dialogue space (FLI-MDS) in Ghana shows the need for a physical and institutional space to cater for and merge different stakeholder interests. For all stakeholders, the institutional space is a multi-level-playing institution which can trickle systemic change by leveraging the private sector's investments with multi-stakeholder collaboration, interactive learning, and potential support for commercial scaling of FLI. For private sector actors, a physical space for collaboration is crucial.

Sixth, 'The implication of the international private sector in the governance of food security in Africa: dissemination of a new agricultural development paradigm' (Marie Hur and Liora Stührenberg) argues that the involvement of international private actors has changed the architecture of food and nutrition security governance, now marked by the proliferation of hybrid spaces in which international firms and philanthropic foundations play a leading role. The very strong connection of the actors involved in these multi-actor platforms and the variation of these platforms at different scales (international, regional, national) ensures dissemination of ideas which emphasize the modernization of African agriculture, based on commercial agriculture and a model of Green Revolution with strong capital mobilization and an emphasis on financial profitability.

The final paper, 'Does participation of agricultural entrepreneurs in knowledge networks improve firm performance in Benin?' (Fréjus S. Thoto, Rodrigue C. Gbedomon, Mawuna Donald Houessou, Augustin Aoudji, and Barthelemy G. Honfoga) analyses data from 819 entrepreneurs to consider the impact of participation in knowledge networks on firm performance. Findings show that agricultural entrepreneurs use both formal and informal knowledge networks, although informal network are used with more intensity. The authors

found that participation in these knowledge networks is influenced by age, gender, education level, and sector of activities. This study provides critical information for institutions that are active in encouraging or crowding out the involvement of the private sector in agricultural and rural development.

Other contributions

The case study, 'Knowledge as catalyst: using knowledge exchange and learning to commercialize a public agricultural research idea for Kenyan and Rwandan smallholder farmers' (Laura Ostenso and Laura Harwig) illustrates dynamics of a multi-year agricultural technology partnership between Feed the Future Partnering for Innovation, a United States Agency for International Development (USAID)-funded programme implemented by Fintrac Inc., and Purdue University, USA. The partnership aimed to scale use of an improved grain storage bag to reduce postharvest loss among smallholder farmers in Kenya and Rwanda. The case presents a set of knowledge exchange touchpoints to facilitate collaboration between publicly funded research institutions and private sector businesses in successfully and sustainably scaling innovative agricultural technologies.

The Reflection, 'Disentangling challenges in mainstreaming smallholder farmers perspectives into knowledge co-creation processes: evidence from Benin' (Mawuna Donald Houessou and Frejus Thoto) considers that although smallholders form most agri-food value chains, their voices and idiosyncrasies are little consulted and accounted for in policymaking. Efforts to improve such situations are ongoing but face operational challenges, usually context-specific, that the literature fails to identify. This reflection addresses the knowledge gap and discusses how to effectively engage smallholders in critical discussions regarding the sustainable transformation of agriculture.

Finally, the Community Note, 'Knowledge management and the coronavirus pandemic: an online discussion' (Chris Zielinski) analyses the online discussion on 'knowledge management and the coronavirus' which took place between 30 March and mid-June 2020 on the Knowledge Management for Development (KM4Dev) discussion list, made up of 80 contributions from 30 participants.

Conclusions and way forward

Taking stock from the contributions of this Special Issue, we highlight two fundamental points on how the private sector can contribute, through knowledge partnerships and brokerage, to transformations towards the achievement of the SDGs. The first point concerns scaling of sustainable solutions, while the second point entails the nexus of learning and inequality. These insights are consistent with the fifth generation of knowledge management for development (KM4D) with its emphasis on the development knowledge system and

ecology, featuring multiple knowledge, multi-stakeholder process and global public goods, against a background of emergence and complexity (Cummings et al, 2013).

First, we overall found that the scaling of sustainable solutions – generally facilitated by the public sector but also by NGOs – requires the design of appropriate knowledge systems, hence of knowledge brokerage by actors commonly perceived as not driven by self-interest. In the cassava sector of South-East Asia, for example, Newby and colleagues (in this Special Issue) found that public or non-government actors were necessary knowledge brokers to scale improved farming technologies because of their built trust with farmers. The private sector, and especially large multinational entities, were found to have the resources and core competencies to create physical and virtual spaces for knowledge exchange (Minh et al.; Hur and Stührenberg; Kiwanuka et al, in this Special Issue), thus to contribute to the foundation of these knowledge systems. Yet, once created, these spaces need everyday organization and orchestration from actors that are commonly perceived by stakeholders to act in the public interest (Kiwanuka et al., in this Special Issue). In particular, these spaces need to be organized in support of those actors with less resources to participate to knowledge partnerships (Houessou and Thoto, in this Special Issue). Moreover, the timing of knowledge exchange within these spaces is particularly important to develop effective knowledge systems that scale sustainable solutions (Ostenso and Harwig, in this Special Issue).

This first overarching finding adds insight to the recent theory and practice of scaling of sustainable innovations (Schut et al. 2020). That is, knowledge management – both in terms of designing structures for knowledge sharing and co-creation, as well as in terms of everyday brokerage – plays a critical role in steering the scaling processes. Thus, not only knowledge systems per se, but also their governance, need to be designed and organized in partnerships between actors pursuing both private and public interests (Dentoni et al. 2018; van Ewijk and Ros-Tonen 2021). This realization leads to the following questions that can be more specifically addressed in future practice and research:

- How can knowledge management be organized among multiple stakeholders – including public and private – during processes of scaling of sustainable solutions?
- Which technologies effectively support processes of knowledge-sharing at scale, both in terms of virtual and physical spaces and channels for communication and storing/access data and information?
- Which practices effectively support stakeholder inclusion in the knowledge-sharing processes at scale? For example, how can resource-scarce stakeholders viably participate and have their voices heard in knowledge sharing and co-creation?

Second, knowledge sharing and co-creation at scale may trigger stakeholder learning processes that may be profoundly unequal. In particular, some stakeholder may learn more rapidly, innovate and empower themselves through knowledge partnerships (Thoto,

Gbedomon et al., in this Special Issue). Yet, others may fail to do so because of their learning environment might not be favorable, despite the knowledge management efforts that might have been put in place (Thoto, Houessou et al., in this Special Issue). Evidence shows that these learning disparities can be effectively addressed at project or programme scale (Ur-Rahman et al, in this Special Issue), but they may persist when scaled at a national or regional level, therefore explaining the mixed success in the uptake of sustainable solutions at scale (Newby et al., in this Special Issue). These learning disparities become even more evident as exogenous shocks – such as the coronavirus pandemic as a global health emergency – force the less resilient stakeholders to focus primarily on short-term needs rather than investing in long-term knowledge acquisition and learning processes (Zielinski, in this Special Issue).

This second overarching result contributes to explaining why multi-stakeholder knowledge partnerships might not lead necessarily to effective processes of multi-stakeholder innovation (Sartas et al. 2018). This means that inequality in learning environments and opportunities may lead some stakeholders, in particular the more resource-constrained and least resilient ones, to benefit the least from knowledge partnerships and brokerage. This finding resonates with recent literature that suggests that social network embeddedness might fuel inequalities in stakeholder learning and innovation (Beaman and Dillon 2018), and therefore more attention needs to be put on how power structures and informal institutions may shape learning inequalities in multi-stakeholder platforms (Iza et al. 2020). This reflection suggests the following questions:

- Is it necessary for responsible scaling initiatives to reduce learning inequalities among stakeholders?
- To what extent are learning inequalities linked to socio-economic inequalities and inequalities related to power?
- Can the scaling of sustainable solutions towards the achievement of SDGs can take place effectively without reducing stakeholder learning inequalities?
- How can knowledge brokerage and training/education institutions reduce processes of stakeholder learning inequality?
- How can private, public and non-profit actors complement the work of knowledge partnerships to reduce stakeholder learning inequalities at scale?

Enjoy the reading of this Special Issue contributions and please reach out to us and the KM4Dev community to foster and steer this important conversation with us in the years to come.

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Can the private sector help deliver improved technology to cassava smallholders in South East Asia?

Jonathan Newby, Dominic Smith, Rob Cramb, Cu Thi Le Thuy, Laothao Youabee, Chea Sareth, Sok Sophearith, Chanphasouk Tanthaphone, Wani Hadiutomo, Lê Việt Dũng and Nguyễn Văn Nam

The cassava sector in South East Asia is a multi-billion dollar industry, with smallholder producers connected to final consumers via complex and diverse value chains. Public sector research conducted with farmers over several decades has generated technologies with the potential to improve farmer livelihoods. However, translating these research outputs into widespread adoption by farmers, with scaling beyond intervention sites, has had mixed success. This has prompted the question whether private sector actors in the cassava industry can have a greater role in knowledge transfer. We develop a framework in which value chain characteristics, as well as the inherent characteristics of technologies and farming communities, affect the potential for scaling of research outputs and widespread adoption by farmers. We apply this framework to an analysis of six contrasting case studies in four South East Asian countries, ranging from underdeveloped value chains around small-scale processing of animal feed to highly-commercialised international value chains for starch. We find that, in particular contexts, such as when farmer adoption of a technology generates increased supply to a single processor, the processor has an incentive to invest in the extension of research outputs to farmers in its supply zone. In other contexts, however, such as when there is intense competition among processors for smallholder output or where the benefits of the technology are not immediate, there is little incentive for private sector involvement. In all cases, we find that support from a knowledge broker, such as a public sector or non-government actor with the capacity to work with farmers, is also required. Hence, the private sector is not a panacea for generating research impacts at scale.

Keywords: sustainable production; agricultural production; value chains; technology adoption; extension; scaling; cassava; smallholders; South East Asia; Cambodia; Indonesia; Laos; Vietnam

Introduction

Cassava (*Manihot esculenta*) is a root crop of South American origin that has long been cultivated by smallholders in South East Asia as a supplementary subsistence crop. Over the past four decades, cassava cultivation has expanded throughout the region into a multi-billion-dollar industry, supplying food, animal feed, starch, and a range of starch-derived products (Lefroy, 2015). Fuelled by expanding market demand, the global supply chain for cassava has extended across borders and deeper into increasingly marginal agro-ecological zones (De Koninck & Rousseau, 2012). Producers are connected to final consumers via a complex and diverse set of value chains involving traders, agents, primary processors, commodity traders, deep-processors, feed companies, livestock farmers, fuel and energy companies, and global multinational food and beverage companies.

Despite being connected to these dynamic global markets, cultivation of cassava in South East Asia continues to be dominated by smallholder farmers, many of whom have low rates of adoption of improved practices and limited access to technical advice. Research conducted over several decades, largely by national and international public agencies with donor funding, has generated a range of improved technologies, including higher-yielding varieties, more appropriate chemical fertilizer formulations, soil conservation measures, and improved methods of pest and disease management. Participatory research trials on a local scale have shown that the adoption of improved cassava production technologies by smallholders can lead to enhanced productivity and sustainability of the sector, contributing to improved livelihoods and economic development (Howeler & Aye, 2014). Nevertheless, the process of translating research outputs into widespread adoption by farmers, with scaling up beyond project intervention sites, has had mixed success.

Although the developmental case for improving smallholder cassava production appears compelling, government policies in South East Asia have not prioritised the cassava sector. Hence, research agencies working on cassava have turned to the private sector as a potential "next user" of research outputs, seeking to partner with agribusiness actors to develop and share useful knowledge with farmers. This change in strategy also follows the currently fashionable emphasis of many donor agencies on engaging with the private sector to achieve development outcomes. For example, the Australian Government's Aid Policy Framework asserts that "through increased collaboration and partnering, business can deliver sustainable social impact in developing countries while delivering commercial returns. The private sector drives productivity and participation which in turn creates economic growth" (DFAT 2015, p. 5). However, there has been limited analysis of the incentives and preconditions for this kind of knowledge partnership to be viable. Does the private sector have the motivation and capability to enter into knowledge partnerships for smallholder development? If so, in what

circumstances and with what support? Has the potential for partnering with the private sector been overstated in agricultural development strategies?

An action research project was undertaken from 2016 to 2020 in four South East Asian countries (Cambodia, Laos, Vietnam, and Indonesia) to examine the circumstances promoting and obstructing effective partnerships between public research agencies and private sector actors in developing and disseminating improved technologies to cassava smallholders. Six contrasting case studies were undertaken in which government and university researchers sought to partner with private sector actors and networks in testing and disseminating a range of improved cassava technologies. The six case studies represented a variety of cassava value chains with different structural characteristics, ranging from localised value chains for small-scale processing of animal feed to highly commercialised international value chains producing starch for various industrial end-uses. In each case-study site, industry stakeholders were identified and engaged through a sequence of activities. These included semi-structured interviews with farmers and value-chain actors at the outset of the project; involvement of these stakeholders in project meetings, the conduct of field trials, and field days; interviews with stakeholders about the results of the research and how to make them more widely available; and informal conversations with key informants. Together, these sources of data enabled researchers to examine the motivations for and constraints to private sector participation in technology development and dissemination in each setting.

In this paper, we present a comparative analysis of the case studies to assess the factors affecting the type and extent of private sector involvement. We first discuss the need to broaden the conventional framework for analysing adoption of farm technologies to include the attributes of value chains affecting the potential for private sector participation in the extension or scaling process. We then use this broader framework to characterise the cassava technologies, farming populations, and value chains examined in each of the case studies. This is followed by a cross-case comparison to highlight the key variables affecting private sector participation. We conclude with some reflections on the scope for effective knowledge partnerships with the private sector.

Conceptual framework

The term “technology” as used here refers to the knowledge incorporated in farming systems, whether as farming practices (such as cropping patterns) or embodied in material inputs (such as crop varieties and fertilisers). We recognise that technology has multiple sources and is not simply transferred uni-directionally from researchers to farmers (Biggs, 1990; Cramb, 2003; Williams and Cramb, 2020). However, there is often a case for taking technologies that have

been co-produced in a particular location by farmers, researchers, and others and transferring them to new locations where they appear to have potential for widespread adoption. Given the high degree of location-specificity of agricultural technologies, these transferred technologies still need to be tested and adapted before broad-scale adoption is likely to occur. It is this more nuanced process of technology transfer, adaptation, and adoption that is assumed in this paper.

Research on the adoption of innovations or new technologies by farmers has focused on the characteristics of the technology in question in relation to the characteristics of the population of potential adopters (Pannell et al., 2006; Pannell & Zilberman, 2020; Rogers, 2003). These two sets of characteristics combine to influence the peak level of adoption within the specified population and the time to reach peak adoption – outcomes that are critical to assessing the overall impact of a new technology. The ADOPT model has been developed to formalise these influences with the aim of predicting adoption outcomes (Kuehne et al., 2017; Llewellyn & Brown, 2020). Within this framework, the key characteristics of a technology are synthesised into two variables – relative advantage and learnability (Kuehne et al., 2017; Llewellyn & Brown, 2020). The relative advantage of a technology encompasses its investment cost, profitability, risk, ease and convenience, environmental impacts, and other attributes. The learnability of a technology encompasses its complexity, observability, and the ease of testing it on the farm (trialability).

The key characteristics of the population of potential adopters are also viewed in terms of relative advantage and learnability (Kuehne et al., 2017; Llewellyn & Brown, 2020). The relative advantage of a technology to a heterogeneous population of farmers will depend on farmers' profit orientation, risk orientation, environmental attitudes, scale of operation, and planning horizon, as well as short-term constraints such as access to credit. Specific influences on the ability of a population to learn about a technology include existing skills and knowledge, farmer groups and networks, and the level of advisory support or extension. The ADOPT framework implicitly assumes the central role of a public extension service, the quality of which strongly influences a farming population's ability to learn about a technology. However, as Norton & Alwang (2020) observe, a number of factors have led to changes in the way extension services are organised and financed. The overall result has been a decline in public extension activities since the 1990s. As Norton & Alwang (2020: 13) remark, "the hope was that the private sector would step in." However, the involvement of the private sector in technology transfer has been very uneven, raising questions about the incentives and capabilities of actors in different value chains.

The globalization of value chains has meant that both farmers and value chain actors have needed to upgrade technologies, often in response to the requirements of lead firms within a contracting arrangement (Reardon & Timmer, 2014). Yet Swinnen & Kuijpers (2019: 298)

observe that "the role of value chains in technology adoption has been largely ignored so far, despite the dramatic transformation and spread of modern agri-food value chains." They point out that "the failure to adopt the technology not only affects the farm but also all other agents in the chain. Technology companies have lower profits since they cannot sell their technology; processors do not get the raw material they need for producing consumer products; and consumers do not get the products they desire. All these agents have an incentive to make the farm adopt the technology" (Swinnen & Kuijpers, 2019: 300). However, we argue that the discussion of value chains as conduits for the transfer of technology to farmers often lacks a nuanced appreciation of the varying incentives and capabilities of actors in different value chains. Not all value-chain actors will be aware of or interested in all technologies, or have an incentive to invest in adapting and transferring these technologies to farmers. Hence, in addition to the attributes or characteristics of the technology and of the population of potential adopters – the key variables considered in the ADOPT model – it is necessary to consider the *characteristics of the value chain in which the potential adopters are embedded*. These characteristics will influence both the relative advantage of farm-level adoption to different value-chain actors and the learnability of the technology in question, that is, the ability of value-chain actors to learn about and communicate the technology.

The relative advantage to a firm of investing in technology transfer to farmers will depend not only on the technology's relative advantage to farmers but also on the firm's individual situation (e.g., size, spare capacity, and access to capital). For example, a processing firm with unused capacity will have greater incentive to promote yield-increasing technology to farmers, such as a higher-yielding crop variety, in order to achieve greater throughput and lower fixed costs per ton of processed product. Relative advantage to the firm will also depend on the industry structure (e.g., number of competitors, degree of industry coordination, and the strength of ties to farmers), affecting the firm's capacity to capture the benefits generated. For example, while the processing firm may potentially benefit from increased farm production, it may not be able to prevent competitors from also benefiting from its investment in technology adoption. This inability to capture the full benefits of technology transfer may reduce the firm's perceived relative advantage.

The learnability of a technology to a value-chain actor will be influenced, not only by its inherent complexity, observability, and trialability, but also by such factors as the actor's existing skills and knowledge, their awareness of current farming practices and available technologies, their industry networks, and their access to technology providers in both public and private sectors (Kuehne et al., 2017). Given the potential benefits to value-chain actors, Swinnen & Kuijpers (2019: 300) argue that these actors can "consider whether it is profitable to set up different types of exchange systems … to help or induce farms to invest in the required technology." They report that, while interlinked contracting between farm and

processor (i.e., "contract farming") has been widely studied, it is possible to "observe many different forms of value chain innovations with successful technology transfer" (Swinnen & Kuijpers, 2019: 300). They present a typology with five models of innovative contractual arrangements, all involving the financing of technology adoption. These range from a buyer (e.g., a processor) financing the farmer's adoption of technology as part of contracted product delivery, through to complete vertical integration. While this typology is a useful starting point, it does not encompass situations where there is no formal contracting or financing involved. Nor does it address the issue of competition between value-chain actors.

In this paper we build on the ADOPT framework by examining the relative advantage and learnability of a range of cassava technologies to value chain actors in six different market contexts. In the process, we also extend the typology of Swinnen & Kuijpers (2019) to encompass contexts with different degrees of competition and the absence of formal contracts and finance.

Case studies

Our extended framework considers the influence on the rate and level of adoption of the attributes of (a) the technologies, (b) the population of potential adopters, and (c) the associated value chain. Each set of attributes is analysed in terms of (a) learnability and (b) relative advantage. This framework was applied to each of the cases. As the available technologies were common to all the case studies, their attributes can be examined first (Table 1).

Attributes of cassava technologies

Of the four types of technology, improved varieties are the most adoptable, given their high learnability and relative advantage. Optimising fertility management through the use of a balanced fertiliser regime is a somewhat less adoptable technology, with moderate learnability characteristics but a high relative advantage. Soil conservation practices are inherently much less adoptable, given their low learnability and the long-term nature of the benefits, which accrue to the wider community as well as the individual adopter (Howeler & Aye, 2014). Similar comments can be made about pest and disease technologies, which require collective action to implement and provide community benefits.

These inherent attributes can be expected to feed through, not only to the population of potential adopters, but also to the value-chain actors who might be motivated to invest in disseminating the technologies to farmers.

Table 1. Attributes of cassava technologies

Technology	Learnability characteristics	Relative advantage
Improved varieties	• Easy to trial given access to planting stakes • Low complexity – little change in farm practices • Observability high at each stage but main evaluation at harvest • Observing starch content more difficult	• Upfront cost low; farmers subsequently use own stakes through vegetative propagation • High reversibility • Impacts realised from first year of use • No community benefit • Relatively low risk; may have higher susceptibility to some pests and diseases • Little or no change in level of convenience
Fertility management	• Moderately easy to trial – but there is low awareness and access of NPK fertilisers suited for cassava and appropriate rates • Moderately complex – fertilizer application depends on type of fertilizer, timing, and location • Observability is good at different stages, but main evaluation at harvest • Observing starch content more difficult	• Moderate upfront costs • Relatively good rate of return • Immediate impact can be high; long-term impact unclear • No community benefits – potential negative environmental externalities • More exposure to risk • Less convenient than no fertility management
Soil management	• Difficult to trial as may be long lag between implementation and observable impacts • Complex – many options including intercropping, soil conservation techniques • Low observability until critical threshold reached	• High labour input in initial years • Higher labour demand throughout the season for intercrops, reducing opportunities for stable off-farm employment • Some benefits in first year of intercropping • Added price and production risk/uncertainty for intercrop • Other impacts have long time horizon • Positive community benefits • Less convenient than no soil management
Pest and disease management	• Difficult to trial due to externalities requiring collective action (e.g., cannot treat one	• Moderate upfront cost • Uncertain private benefits in first year

	field if surrounding fields not treated) • Complexity can be high • Observability may be low as often difficult to connect pest/disease control with yield; no 'with' and 'without' cases to observe	• High community benefits if community-based treatment undertaken

Case 1: Simalungan, North Sumatra, Indonesia

Simalungan is a district in the Indonesian province of North Sumatra, centred on the city of Pematang Siantar. The city and district combined have a population of 1.1 million and a density of 253 persons/km^2. The terrain is undulating to hilly and the climate is humid tropical, with an annual rainfall of 2,894 mm distributed evenly throughout the year. Smallholders plant a variety of field and tree crops for subsistence and sale, making use of credit for inputs. Cassava farmers rely on a few traditional varieties of unknown origin and apply sub-optimal amounts of inappropriate fertilizer, averaging around 30 metric tons per hectare (t/ha). Cassava is not designated as a priority crop for the government extension service, which consequently had little involvement in the project.

The project worked with a starch factory established in 1974 in Pematang Siantar that is the sole buyer of fresh roots for most cassava smallholders in the district. The factory produces starch for the domestic market and is not well connected to R&D agencies, concentrated in Java. The company works through seven or eight agents who coordinate supply through a network of local traders, each of whom has their own network of farmer-suppliers. Credit for production inputs is channelled through these networks but there is no formal contracting. Side-selling is minimised by the monopsonistic nature of the local processing market, the high transport costs, and the high degree of personal trust among traders. If the factory has excess supply, it will allow its traders to sell elsewhere but, during the research, the factory was operating at only 40% of capacity.

Given these attributes, the company's management was very interested to cooperate with the research team, particularly in varietal trials to increase farm yields and hence the supply of cassava roots to the factory. The company provided land for the first set of varietal trials, which were managed by a lead-agent who was also a cassava farmer. Traders and farmers inspected these trials during field days and evaluated varieties for subsequent testing. The company paid for additional planting material to be shipped from Java, and some agents and traders took stakes of the new varieties for testing and multiplication on their own land, with subsequent dispersal to farmers.

The company was also supportive of fertilizer trials conducted in combination with the varietal testing, again expecting increased yields. However, problems with sourcing an appropriately formulated commercial brand and a bias in government policy towards subsiding fertilizers for rice made it difficult to translate the fertilizer trials into farmer adoption. The company also supported the intercropping trials proposed by researchers, not for reasons of improved soil management but in the expectation that, with a productive intercropping system, farmers might continue to grow cassava in times of low prices.
The factory's agents played a critical role in transmitting knowledge from the central node to farmers via their trading networks. However, the agents differed in their commitment to this process, based not on differences in their ability to capture profits but on individual attributes. More generally, late in the project, when financial pressure on the company was resulting in delayed payments along the value chain, the loyalty of some agents to the factory was tested, inducing them to seek out a more distant starch factory to supply.

In sum, the company was willing to invest in a research partnership to generate and disseminate highly adoptable technologies (varieties, fertilizer-use) that would increase farmers' productivity and hence factory supply, knowing that it could both disseminate the technologies and capture their benefits through its informal but stable supply network and its position of effective monopsony. However, even in this case, financial pressures could disrupt the process of knowledge transfer.

Case 2: Son La, Northwest Region, Vietnam

Son La is a province in the mountainous Northwest Region of Vietnam, centred on Son La City. The province had a population of 1.2 million in 2018 and a density of 85 persons/km^2. Farming is carried out on steeply sloping land that is susceptible to erosion and declining yields, especially with the recent transition to continuous cropping of field crops like maize and cassava. Son La has a humid sub-tropical climate, with an annual rainfall of 1,434 mm, 85% falling in the summer months (April-September). Because of this strong seasonality, cassava processing only occurs for five to six months of the year. Farmers grow traditional landraces with low tuber yield (averaging 12 t/ha in 2013) and low starch content, partly a function of the steep terrain and rudimentary management. The association of cassava with land degradation on the sloping lands has resulted in the local government supporting a transition to tree crops such as coffee and fruit trees rather than the development of sustainable cassava systems. Despite this, cassava has remained a critical source of livelihood, both for cash income and on-farm utilisation as livestock feed.

At the outset of the research, there was one company with a starch factory but many processors of dried chips (used for livestock feed). Hence farmers were not committed to supply the factory, as they were in Case 1. Now there are two starch factories and two more planned, increasing the degree of competition for cassava roots. Although the company was

interested in collaborating in the research project, its factory was operating at full capacity. Hence the company's management was mainly interested in developing technologies for farmers to extend the harvesting period beyond the current six-month window (which was as much a financial as a technical question), and in varieties with higher starch content that would improve processing efficiency. The company was interested in disseminating improved varieties with higher starch yields through its trader network, but only if someone else incurred the cost of multiplying the planting material. There was a constraint in that, while local management was interested in a research partnership, the company's head office, which controlled spending, was in Ho Chi Minh City, remote from conditions on the ground. The company had little incentive to promote more appropriate fertiliser use because of the steep terrain (reducing the effectiveness of fertilizer outlays), its lack of capacity to process more roots if yield was increased, and the risk of side selling, given the number of alternative buyers. Likewise, there was little incentive for farmer adoption or factory promotion of conservation agriculture, given its low ranking in terms of learnability and relative advantage (Table 1). However, there was evidence that the project's on-farm demonstrations had encouraged farmers to take more care in planting the cassava stems, providing a low-cost improvement to yields. There were also positive signs that local government would strengthen its cassava extension in recognition of the importance of the crop to ethnic minority households, thus compensating for the limited capacity of the processing company to take on this role.

Case 3: Dak Lak, Central Highlands, Vietnam

Dak Lak is a province in the Central Highlands Region of Vietnam with a population of 2.1 million in 2019 and a density of 160 persons/km^2. The terrain is undulating to hilly and the province has a tropical savanna climate, with annual rainfall of 1,600 mm concentrated in the summer months (May-October). The farming system includes a range of annual and perennial crops and livestock, with a steady increase in perennials such as coffee and pepper. However, poorer farmers still plant cassava because it is easy to grow and requires a low investment.

There are many starch factories in the province, processing cassava roots during most of the year. At the start of the project there was less competition, with factories able to draw on a specific catchment. Factory numbers have now increased to 11, with overlapping supply zones. All factories are short of supply and purchase roots from further afield to increase their throughput. Competition for roots is intense and margins are small. However, there is one ethanol factory that produces its own supply. In this case, company management was more interested in cooperating with researchers in knowledge development. The starch factories clearly had limited incentive to invest in collaborative research and dissemination for any of the technologies listed in Table 1 due to the extreme competition, lowering the relative advantage to each actor. Investment in yield- or starch-increasing technology by one firm

would potentially provide benefits to all other firms, all of whom were seeking to better utilise their capacity. There was also a perception, given that a government extension system is in place, that disseminating technologies to farmers is "not their responsibility" (as stated by a factory manager at a stakeholder consultation).

Nevertheless, in the past, networks of factories from this region were buying newly-released cassava varieties from Tay Ninh Province to the south to distribute these to farmers. There is likely a good business case for the formation of a processors' association that could levy its members for such research and dissemination activities. This becomes even more urgent now that diseases such as Cassava Mosaic Virus (CMV) are contaminating the value chain, causing potential economic hardship to both farmers and processors.

Case 4: Xayabouly, Northern Laos

Xayabouly is a province in Northern Laos west of the Mekong River, bordering Thailand. The population in 2005 was 381,000 and the density, 23 persons/km^2. The terrain is flat along the narrow floodplain, but much of the province is undulating to hilly. The province has a tropical savanna climate, with an average rainfall of 1,282 mm, concentrated in the summer months (May-September). Rice-based farming systems predominate but farming has become more intensive and commercialised in recent decades, supplying cross-border trade with Thailand during successive crop booms, including for maize and cassava. Cassava production is undertaken by independent smallholders who supply fresh roots over a six-month period (November-April) to a foreign-owned starch factory in Paklai District and to dried chip processors. Cross-border trade in fresh cassava roots has been blocked by provincial regulation to encourage value-adding and maintain the viability of the single starch factory.

The project worked with the foreign-owned starch factory, which is directly supplied by surrounding farmers. This factory operates at full capacity early in the harvest season, but then has spare capacity. It has an incentive to support existing knowledge networks to promote yield-increasing research and dissemination, particularly if it can purchase more roots over a longer period and prevent leakage in its supply to dried-chip processors.
The research found scope for farmers to adopt simple improvements in management practices (such as the selection of disease-free stems for next season's planting) that were low-cost and yield-increasing, while maintaining starch content and processing efficiency. Similarly, despite recognising declining yields, no farmer surveyed was using any fertiliser. A series of demonstrations showed good rates of return to low levels of fertiliser application, even at low cassava prices. This information could be provided by the company at little cost, given its direct link to farmers.

The company already pays a levy to the District Government based on the weight of roots processed. The possibility of directing part of the levy into extension activities was being

explored with the processor and the local government at the time of writing. Concerns over leakage of into the chip market was the main issue being discussed.

Case 5: Kratie, Eastern Cambodia

Kratie is a province in eastern Cambodia, spanning the Mekong River and bordering Vietnam in the southeast. It had a population 372,000 in 2019 and a density of 34 persons/km^2. The climate of Kratie is tropical monsoonal, with an annual rainfall of 2,095 mm concentrated in May to October. Farming is concentrated along the Mekong corridor, phasing into thick forest in the east of the province. The terrain is flat and soils are sandy. Farming systems are rice-based, with increasing areas of forest being cleared for field crops like cassava, often followed by perennial crops like cashew and pepper. As in other cases, however, poorer farmers continue to be reliant on cassava.

The province has been a frontier for the expansion of cassava production, supplying fresh roots to starch factories in Vietnam's neighbouring Tay Ninh Province. There is a large processing capacity in Tay Ninh, with over 60 large starch factories supplied by Vietnamese growers. High demand pushed the extensive margin of cultivation across the border into Kratie. When prices slumped, a significant proportion of Kratie's production was diverted as dried chips to Binh Phuoc Province in Vietnam. With the recovery in prices, the extensive margin for suppliers of the Tay Ninh starch factories has been pushed beyond Kratie to provinces to the north and west.

The cross-border trade involves a value chain with a break at the border. Cassava roots are transported by Cambodian traders to the border, where they are reloaded onto Vietnamese trucks. Hence, in contrast to Cases 1 and 4, there is no direct relationship between the Cambodian farmers and the Vietnamese processors or their agents. There have been attempts to develop a processing sector within Kratie. A factory was established close to Kratie town at a time when world prices were low and demand from Tay Ninh was reduced but, with resurgent demand from across the border, it cannot compete with traders selling into Tay Ninh. Traders have low overheads and can offer farmers a better price, despite the transaction costs at the border. A second company has recently opened a factory within Kratie Province and is contemplating contract farming to tie in its suppliers.

The project could not identify a private sector knowledge partner in this situation. There was no interest or awareness in partnering from the processors in Vietnam due to the break in the flow of information and connections at the border. Processors in Tay Ninh were aware that, during the local off-season, around 80% of the fresh-root feedstock was coming from Cambodia, but they had no direct connection to Cambodian farmers. Traders were only interested in filling short-term orders passed down the chain. Public sector agencies also had limited capability to work with cassava farmers, restricting the effectiveness of the project. In

Cambodia, non-government organisations (NGOs), including microfinance institutions, have proliferated to fill the gap left by the public sector, but their activities are fragmented and mainly concentrated on upstream activities rather than linking with downstream actors. There is an urgent need in Cambodia to coordinate the supply of planting material that is not only high-yielding but also disease-free, due to the spread of CMV and Cassava Witches Broom Disease (CWBD). In theory, processors should be interested in ensuring farmers use clean planting material as this will increase root yields and starch content. However, in the short term, if CMV reduces yields, they can simply source roots further afield to maintain their throughput. Moreover, if one firm supplies disease-free stakes it has no guarantee that this will control the spread of the disease, nor that it will benefit from the higher yields and starch content. The first step is for a public agency to establish a source of clean planting material and then supply this to accredited private sector actors for multiplication and sale. As technology suppliers, it would be in the interest of those actors to increase farmers' knowledge about the general benefits of disease control. The same argument would apply to a private supplier of an appropriately-formulated fertiliser for cassava growers.

Case 6: Sikka, Nusa Tenggara Timur, Indonesia

Sikka, on the island of Flores, is a district in the province of Nusa Tenggara Timur (NTT) in eastern Indonesia. It had a population of 300,000 in 2010 and a density of 173 persons/km^2. The climate is tropical monsoonal, with an annual rainfall of only 1,139 mm concentrated in the summer months (November-April). There is a narrow flat coastal plain in the north, rising sharply to steep, mountainous terrain. Conventional dryland farming of maize, cassava, and pigeon pea is practised on the plain, while the sloping uplands support a highly diverse agroforestry system, with field crops such as upland rice, maize, and cassava interspersed among tree crops such as coconut, cocoa, coffee, cashews, and tamarind.

Here cassava is grown as a major staple food for home-consumption and trade in local food markets. Hence traditional "sweet" eating varieties are utilised, with few or no inputs. Farmers practise piecemeal harvesting when they need food or cash. The price of these eating varieties in the market is higher than that of industrial ("bitter") varieties. There is a small-scale cottage processing industry producing cassava-based food products for local purchase but no processing for animal feed or starch. The project experimented with introduced varieties and alternative multi-cropping systems on farmers' land. The research conducted with farmers demonstrated that increasing the density of cassava within the traditional maize-cassava system could improve the yield and income generated from cassava, without a decline in maize production as feared by farmers.

In partnership with the project, an entrepreneur established a pilot processing plant for animal feed and invested in distributing a new, high-yielding industrial variety (Malang 4) to farmers in both upland and lowland locales in Sikka and a neighbouring district. The transaction costs

associated with the dissemination of technology to a relatively small number of farmers resulted in the price he was offering being substantially lower than the price farmers could get from the piecemeal selling of their cassava to food traders. Though Malang 4 is considered an industrial variety, it can also be consumed as a food crop with some additional processing (i.e., soaking in water). The extensive opportunistic side-selling was thus threatening to undermine the viability of the pilot project and ongoing expansion of the processing capacity.

In this case, stakeholder consultations indicated a strong argument for a public-private partnership to lower the cost of knowledge transfer, with the local agricultural office providing initial support in introducing suitable varieties and multiplying them while the processor distributes them to farmers. An NGO or development project could catalyse and support the process.

Discussion

The degree of private sector interest and involvement in the project's research agenda in each case varied with the characteristics of the technology, of the farming population, and of the value chain. Both farmers and value-chain actors were most interested in utilising cassava varieties that gave higher tuber and starch yields and, to a lesser degree, in managing soil fertility through application of appropriate fertilizer doses. These technologies had high learnability and relative advantage. However, although there was a degree of interest in and awareness of the impact of cassava diseases, the low learnability and (individual) relative advantage of disease control measures discouraged adoption and dissemination. Technologies for soil conservation were also characterised by low learnability and (individual) relative advantage; hence there was little or no interest in these technologies, even for the steeply sloping land of Northwest Vietnam where they are most relevant.

The attributes of the farmers in each case also influenced the degree of private sector involvement. In all sites but Sikka, farmers grew cassava purely as a commercial crop and were motivated to adopt technologies that could be demonstrated to increase their farm income in the short run. Mostly operating with trader credit on an annual planning horizon, they were understandably less interested in more complex technologies involving up-front investments with long-run benefits. Even in Sikka, where cassava was grown primarily for home consumption, farmers were sensitive to relative market prices for food and industrial end-uses, undermining their commitment to supply a pilot feed industry. Though public extension services varied between cases, being better resourced in Indonesia and Vietnam than in Laos and Cambodia, in no case was there adequate provision of extension for cassava smallholders.

Overlying these two sets of characteristics were the characteristics of the value chain. In all six cases, the focus was on the role of the processor and of the traders linking the processor to the farmers. This is closest to Model 1 in the typology of Swinnen and Kuijpers (2019: 301), in which "the company that buys the farm's product (be it a processing, a retailing, or trading company) finances the technology as part of a contract." However, in none of our cases was formal contracting involved. Rather, processors interacted with farmers through informal networks of traders with varying degrees of social capital. In the absence of enforceable contracts, the strength of these networks was a function of the degree of competition in the value chain and of the number of links in the transfer of product and information from farm to processor, particularly with respect to cross-border trade. Moreover, the flow of finance in these networks provided the working capital for farmers to purchase inputs and traders to purchase the harvest. This credit was not tied to technology transfer as such, though processors and traders did in some cases provide improved planting material to "their farmers", and the project explored the feasibility of using these channels to supply appropriate fertilisers.

The types of value chain structure reported in the case studies are characterised in Table 2. The Simalungan case provides a baseline with regard to value-chain attributes. It can be regarded as an "embedded monopsony" in that it was the sole buyer in the district and had long-established links to its farmers through a network of agents and collectors. In addition, the factory was operating at below capacity. Hence the company was very supportive of collaborative efforts to test and disseminate improved varieties and fertiliser practices, contributing land, manpower, and finance. However, both the strength of the company's supply network and the degree of support for the project did vary with the market price of starch and other financial pressures. Thus, even in the case of an embedded monopsony, relying on a single company as a partner in technology transfer entails risks.

Table 2. Types of value chain found in the case studies and implications for private sector knowledge partnership

Structure of value chain	Cases	Involvement in knowledge partnership[1]
Embedded monopsony	Simalungan, Indonesia	High
Connected competitor	Son La, Vietnam Paklai, Laos	Moderate
Competitive linking	Dak Lak, Vietnam	Low, requires assured coordination
Disarticulated	Kratie, Cambodia	Absent
Self-contained	Sikka, Indonesia	High, but unsustainable

Note 1: "High" refers to involvement in project interviews and meetings, and investment in field activities over successive years. "Moderate" refers to involvement in project interviews, meetings, and some field activities. "Low" refers to involvement in project interviews and some meetings. "Absent" is self-explanatory.

The two sites in Vietnam show the potential for processors to collaborate in disseminating the more adoptable technologies. The factory in Son La was initially the sole starch processor, with direct links to farmers, but faced stiff competition from the many dried chip processors. Moreover, its factory was operating at full capacity. Nevertheless, there was genuine interest in research collaboration, particularly in extending the seasonal window for harvesting and processing. It can be regarded as a "connected competitor". The starch factory in Paklai, Laos, was in a similar situation in that it operated at full capacity for a short period and was interested to collaborate in disseminating technologies to extend the processing period. Though directly linked to farmers and protected from cross-border competition, it too faced the leakage of supply to dried-chip processors. There was potential to involve this factory further in disseminating low-cost improvements to farmers.

In Dak Lak there was more intense competition between the many starch factories, hence less incentive to collaborate in disseminating yield-increasing technologies, despite the prevalence of spare capacity. Nevertheless, networks of factories had collaborated in buying and distributing planting material in the past. This case pointed to the need for industry coordination, or "competitive linking", such as through a processors' association that could levy its members for research and dissemination activities, thus overcoming the free rider problem.

The case in Cambodia illustrates the additional problems associated with value chains that span borders, reducing the informal ties between processors, traders, and farmers. This can be characterised as a "disarticulated value chain". The Vietnamese processors saw no relative advantage in disseminating technology to Cambodian farmers, with whom they had no relationship, formal or informal. Likewise, the traders on both sides of the border were only interested in making spot transactions in a volatile market. Hence the project could not identify a private sector knowledge partner, and government and non-government agencies were ill-equipped to step in. To meet the urgent need for a supply of disease-free planting material will require a public agency to take the lead, perhaps then linking to private sector technology suppliers who would thus have an interest to increase farmers' awareness and knowledge about disease control.

The Sikka case in eastern Indonesia reflects a "self-contained" value chain, where farmers produced for household and local consumption. Here the private sector actor was operating much closer to Model 1 of Swinnen & Kuijpers (2019), financing the testing and dissemination of high-yielding industrial varieties in order to create a new value chain in which he would be acting as a monopsonist. However, in the absence of a contract or the social capital seen in the North Sumatra case, and with farmers having the option of side-selling into the existing value chain, the private investment in technology appeared unsustainable.

The comparison of cases shows that different incentive structures for engaging in knowledge partnerships exist within each value chain, depending on the type of technology, the farming population, and the potential for value-chain actors to capture benefits from the dissemination of the technology. This potential is in large part a function of the structural characteristics of the value chain, though the personal attributes and relationships of individual actors played an important role. This implies that private sector actors can be powerful partners in technology dissemination if the incentive structure is in place, but in other cases the private sector has little or no incentive to get involved.

It is important to note that the research did not find a case where the private sector had spontaneously become involved in research-based technology dissemination. Hence, even where there is an underlying business case for such involvement, there needs to be facilitation by a public sector (or NGO) actor. Successful knowledge partnerships can often be traced to the activities of one or a few local "champions" in business, government, and/or research who spark the process and keep it going. Moreover, the private sector partner may face constraints due to lack of knowledgeable staff, high turnover of staff, lack of capabilities to undertake participatory research, or language and cultural barriers (especially with foreign ownership), again pointing to the need for public-private partnering. Also, it cannot be assumed that private sector actors will have the necessary sensitivity to equity issues. A further point that underscores the need for public sector involvement is the need to coordinate contributions from value-chain actors that benefit the whole industry, as in the case of distributing disease-free planting material. While there are some examples of spontaneous coordination, it is likely that government regulation is needed so that participants are assured of mutual compliance.

Table 3. Key conditions for effective knowledge partnerships with private sector actors, based on results of cassava case studies

A fund of adoptable technologies (i.e., with moderate to high relative advantage and learnability) requiring no more than local adaptation
A commercially-oriented farming population, experienced in repeat-dealing with stable agribusinesses
An articulated value chain that establishes strong, enduring links between farmers, traders, and processors
A market structure OR industry regulation that assures agribusiness actors of capturing the benefits of investing in improved farm productivity
Absence of policy constraints such as distortions in fertilizer pricing or sudden changes in cross-border trade restrictions
Involvement of a knowledge broker to catalyse and support the partnership (e.g., a public agency, a university, a development project, or an NGO)
Individual actors with the interest and capabilities to pursue these partnerships

These requirements for partnering with the private sector are summarised in Table 3. The "key conditions" listed can be regarded as provisional generalisations arising from the cross-case analysis and are not intended as a simple recipe for knowledge partnerships. As we have emphasised, there are many case-specific factors that restrict our ability to make such firm generalisations. Nevertheless, these key conditions can serve to delimit situations where private sector partnerships are more likely to succeed.

Conclusions

The research reported here sought to examine the circumstances giving rise to effective partnerships between public research agencies and private sector actors in disseminating improved technologies to cassava smallholders. We found that favourable circumstances depend on the attributes of the technology, the attributes of the farming population, and, crucially, the attributes of the value chain. In particular contexts, private sector value-chain actors have incentives to invest in the extension of research outputs to smallholder farmers, even without formal financing and contracting, but generally not without initiation and support from public sector actors or other knowledge brokers. In other contexts, however, there is little incentive for private sector involvement, and public sector or non-government actors will need to take responsibility for supporting smallholders with their technology needs. Thus the private sector cannot be seen as a panacea for generating research impacts at scale.

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Knowledge management unlocks market systems for poor women farmers in Bangladesh

Albaab-Ur-Rahman, Emily Janoch and Prabodh Devkota

CARE Bangladesh has long worked with the private sector to find market-based solutions to help the extreme poor, especially women and girls, graduate out of poverty. Social inclusion into market systems is critical to this graduation. Similarly, the integration of information technology has potential for impact at scale. In two of the most successful experiences, the Agricultural Extension Support Project and Strengthening the Dairy Value Chain, unlocking partnership with the private sector, understanding needs and expectations among CARE, private sectors and communities helped to co-create innovative information usage and manage knowledge transparently. Strengthening the Dairy Value Chain, with support from the Bill & Melinda Gates Foundation, used new Digital Fat Testing machines to make milk quality very transparent to producers and buyers, and pay a premium for higher quality milk. To do so, the project combined field collected data on milk quality, farmers' profile, including geographical locations over google map, which enabled private sectors to have detailed supply chain information including quality milk, volume and female farmers' as active producers., This also helped private sectors understand which female farmers needed capacity building support to strengthen their ability in business planning and productivity. This gender focused experience was transformative in the sense that this enabled Aarong dairy (the second largest dairy company in Bangladesh) to work in a targeted manner in scaling smallholder women's participation in their supply chain from 2% to 55% in just 4 years. Brokering knowledge between different private sector actors, from smallholder farmers to large scale companies, was a turnkey solution that unlocked broader inclusion of poor women farmers in fresh dairy sector. In a highly gendered society like Bangladesh, women's mobility, voice, control over asset, financial decision making are limited. When these multiple forms of discrimination are coupled up with poverty, the intensity of marginalization is much deeper and have inter-generational impact requiring dynamic multi-stakeholder approach to be addressed. The Agriculture Extension Support Project, with support from USAID's Feed the Future, worked with banks and communities to get new agricultural financing to women who normally would not be able to access them due to various constraints. Combining digital technology, local agro-dealers, and new knowledge about a potential customer base, the project was able to facilitate the

information and knowledge process in a way that allowed banks to engage a new customer base and co-create an innovative practice that helped transforming the financial inclusion of small holder women farmers. The pilot phase allowed 3,100 people, more than half women, to access USD190,000 in loans to improve their agricultural productions, at less than half of the interest rate they would have been charged with other sources.

Keywords: knowledge management; market-based solutions; value chains; agricultural extension; private sector; financial inclusion; gender; social inclusion; knowledge brokering; dairy; Bangladesh

Introduction

This paper looks at the role of Knowledge Management (KM) in agriculture, market systems, information technology and gender equality. KM has its beginnings in late 1980s to early 1990s in US (Milton, 2018), when corporations were trying to retain and transfer their knowledge as their workforces transitioned with new technologies like Chapparal Steel and PwC. KM addressed these issues by providing a system that enhances organizational performance and impact by enabling adaptive management with timely and appropriate decision-making. Similarly, KM practices spread to International Development, where its importance grew as a tool for improving aid effectiveness (Bosch, 2019). In 2005, the Paris Declaration on Aid Effectiveness highlighted managing for results as a fundamental core, similar to private sector goals. More recently, in 2015 all member states of the United Nations (UN) adopted the 2030 Agenda for Sustainable Development and committed to achieving 17 Sustainable Development Goals (SDGs), in a global partnership (UN, 2015). Effectiveness for development in the framework of SDGs is a contemporary challenge requiring KM. CARE draws extensively from existing theory in the Knowledge Management space to shape KM work. CARE's formal definition of knowledge management is adapted from NASA (undated), and states that 'Knowledge management is the process of CARE, partners, and participants, accessing and applying relevant knowledge to solve problems and measurably improve impact' (CARE, 2018).

Bangladesh is one of the 5 countries which make up half the world's extreme poor population (Defined as living on less than USD1.9/day) (Katayama and Wadhwa 2019). With high population density, low human resource development labor intensive sector like agriculture plays a key role in Bangladesh's development consistent rapid economic growth, contributing 14.1% of GDP, while providing 40.6% of its employment. Achieving self-sufficiency in major food staples stabilized inflationary pressures created by country's rapid economic growth, where 68.1% of women of in labor force are directly engaged, being the driver of change (Ahmed

2020). Despite high participation, women in agriculture face gendered barriers in controlling resources, accessing markets that prevent them from acquiring the full benefits of economic growth. So is the case in Bangladesh where women, especially the women farmers are yet to realize their full potential due to gendered and exploitative power structures. However, as this paper will illustrate, there are market-led collaborative practices that address these gendered barriers and empowering women to play the role of an important economic actor in the society.

This paper explains how CARE Bangladesh engaged with private sector to create gender-sensitive inclusive business solutions that benefit both market actors and women from marginalized communities in agriculture. It begins with CARE Bangladesh's approach to understand the broader eco-system, extract knowledge and manage it with private sector partners and communities to explore 'mutually beneficial solutions'. Applying knowledge management from the lens of solving problems and improving impact allowed CARE to work collaboratively with women producers and the private sector to come to solutions that would not have been possible from one perspective alone. The approach is exemplified in two case studies with focus on fresh dairy market systems and financial inclusion of women smallholder farmers respectively. The strategic architecture of knowledge management to bring these actors together for a shared vison of mutual benefit helped garnering market-based solutions, managing private sector partnerships, helping communities to overcome gender and economic barriers by following adaptive management practices.

Figure 1: KM Cycle (Source: Deloitte)

Co-creating and managing knowledge with private sector

CARE Bangladesh's Private Sector Engagement approach adapted this model of KM (see Figure 1)[i] for its engagement with private sector. NGOs and private sector have mutual interest in engaging the poor and marginalized population while they have mutually solvable problems. Private sector companies don't know enough about this potential market to engage them successfully. At the same time, NGOs who have extensive knowledge of women's needs and

constraints and aim to engage them in better livelihoods, but struggle to convince private sector actors that investing in poor women makes business sense. This is addressed in CARE's approach to private sector engagement as a knowledge broker. With decades of working experience, CARE has collected in-depth profile of poor and marginalized groups which CARE, women, and the private sector can use collaboratively. This collaboration results in customized good and services tailored to needs of economically and socially disadvantaged groups. These products/services are piloted in partnership, assessed on their performance, and go through iterative improvements to settle on product/services pricing, characteristics that private sector can then scale on their own. Thus, the private sector and CARE combine their skills to design and pilot goods and/or services together for targeted impact group with direct feedback from and information sharing with the impact group – poor women farmers in this case.

Principles of KM allow flexible design and rapid adaptation that is required when the development sector perspective meets the profit-driven goals of private sector actor. The steps in the cycle are exemplified by case studies in subsequent sections. The case studies below show how KM principles provided viable market-driven solutions that induced meaningful inclusion of women in market systems and access to finance.

Case 1: SDVC – KM changing industry practices for inclusion of poor women dairy farmers

The Strengthening Dairy Value Chain (SDVC) project assisted the second largest fresh dairy product company in Bangladesh to shift to an alternate sourcing method, called the Dairy Hub Model (see Figure 2) working with 30,000 women who were landless small dairy producers with monthly income being between USD20-30, and livestock of 2 to 2.9 cows. The Dairy Hub Model is a supply chain which targets smallholder dairy producers (mostly women) as source of fresh dairy in a commercially viable manner. It aimed to transform role of women as productive economic actors by establishing direct business relationship with large companies. Doing so required transforming the market space, changing mindsets and attitudes of market actors towards recognition of women who were small dairy producers as viable suppliers. Simultaneously, enabling these women with market knowledge, business skills and mindset with increased market access, confidence and leadership skills required to work with large companies, building economic agency and decision making ability in their homes and business. As the barriers to women's inclusion are also social, it involved engaging men and boys at community is equally important to create enabling environment for these women so that the broader eco-system is women friendly. Meanwhile, the information system and knowledge management

efforts were centered around gender aspects so that issues faced by women are understood and proper planning, processes are established for adaptive management.

The broader systemic challenges of women's inclusion in economic participation is evident across indicators of economic participation. Bangladesh ranks 141st out of 153 countries in Economic Participation and Opportunity for women according to Global Gender Gap Index, 2020. As of 2018, 38% of adult women were part of the labour force (up from 34% in 2017), compared with 84% of men and estimated average annual income of women is 40% that of the men. Discriminatory gender norms limit women's mobility, economic opportunities and most importantly ability to access, own and control their own assets and resources. Thus, even though most rural households have cows, the care of which falls on the woman, cows are seen as a safety net asset and not a business investment (Sebstad and Cohen 2000). The World Bank study in Bangladesh highlighted that women have had a limited role in the household decision-making, limited access and control over household resources (physical and financial assets), low level of individual assets, heavy domestic workloads, restricted mobility and inadequate knowledge and skills leading to higher vulnerability. It is these challenges in light of which the SDVC project was designed.

KM approach, use and success

KM was one of the 4 key objectives of SDVC defined as 'Share learnings on Dairy Hub Model and advocate for adoption by other participants in the Bangladesh dairy industry.' To do so, the project worked to increase capacity of dairy farmers, improve transparency and fair pricing for farmers and increased access to quality inputs and services. SDVC also enabled adoption of dairy hub model within Aarong and beyond with timely information and promoted a more gender inclusive value chain which increased women's control over resources and decision-making. From inception, the aim of SDVC was to scale the Dairy Hub Model beyond project, enabling Aarong dairy to expand with more chilling plants in new areas with other companies copying the model as they see profitability in it, changing the industry practice.

To do so, the project had a robust monitoring and evaluation team who worked directly at the chilling plants to gather evidence of success while also encouraging potential high-performing dairy producers to move up to being forward market actors as positive role model for other women dairy producers. As such, women dairy producers went onto become collectors and group leaders collectively bargaining price and supply volume requirements directly with company representatives – a role left exclusively to male actors at start of the project. In addition, resources were allocated not only for standard monitoring and evaluation (M&E) practices but also for a set of knowledge documents that would replication of Dairy Hub Model by other companies or scaling within Aarong Dairy.

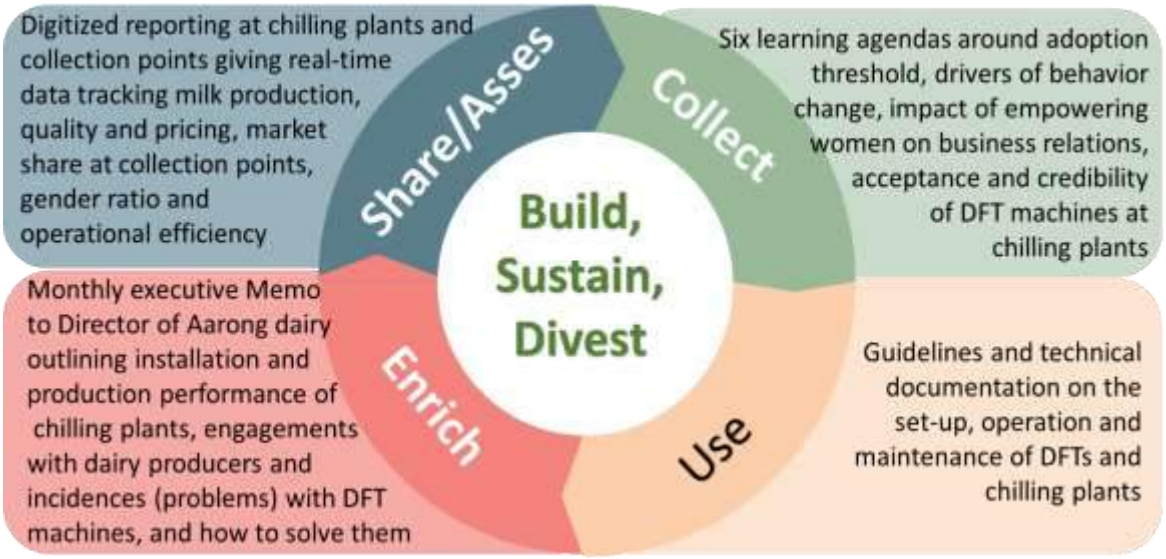

Figure 2: Dairy Hub Model

Collect - At the conception stage, SDVC II extracted knowledge and learning from Phase-1. This provided CARE with vital knowledge about the women dairy farmers, their demographic, psychographic and livelihood related understanding. This enabled CARE Bangladesh a detailed evidence-based understanding of what impact group needs and the key market failures that were preventing women dairy producers and large scale private sector companies from connecting effectively with each other. Importantly, many of the key barriers were related to knowledge management both for women and for Aarong Dairy. These included lack of transparency and information about milk quality, prices, areas where services were available, and where there were women dairy producers who could connect to Aarong.

Use: Using the understanding of Fresh Dairy sector and female dairy farmers, CARE approached this complex market system with contradictory positions and competing interests among the Private Sector Company, women milk producer and CARE., This enabled SDVC to work as a facilitator by sharing supply chain insights, behaviors, and evidence based adaptive management with the private sector; developing scalable models to work with small holders more effectively and incentivizing factors for changing behavior, mobilizing resources from other actors, while strengthening role of women farmers. It also focused on tools to make relevant information more transparent to women around prices, the quality of milk, and ways to improve their milk production.

Enrich: The main challenge of sourcing fresh dairy from remote dairy producers is its very short shelf life. Raw milk spoils in about 3 hours from collection. To increase this time, it has to be chilled, which doubles it to 6 hours when it can be transported to the main factory to be pasteurized and packaged for retail sell. Thus, chilling plants are a pre-requisite for collecting milk from distant sources. Aarong Dairy planned new chilling plants closer to smaller (poor) dairy producers to bring them under its supply chain. However, with chilling plants being very expensive, only a limited number could be set up and as most poor households across the nation have some cows for dairy production, the key question became where to set them up for maximum supply. SDVC carried out GIS mapping of dairy farmers across project areas to identify high producing clusters. Then through data triangulation the locations of chilling plants were chosen so they were equidistant (as much as possible) from a number of milk producing clusters required to fulfill production capacity. With detailed information on farmer's level of understanding, production technique, daily production amount and other factors, Aarong could take a more informed decision regarding its supply chain expansion. Consequently, poor women dairy farmers got access to a chilling plant within reasonable distance where they could regularly sell milk instead of depending on volatile, random local demands from collectors etc. This process also established the recognition of female dairy producers are economically productive and visible stakeholders of the respective dairy supply chain.

Share and assess: For a successful operation of Dairy Hub Model, the private sector and small dairy producers needed mutual understanding and shared goals. CARE served as liaison, matching business goals of Aarong with those of women dairy producers, identifying gaps and needs for mutual benefit, understanding gender and social norms and identifying efforts to help women farmers to play bigger role while addressing geographical and technological challenges of operating chilling plants etc. all towards achieving wider systemic changes. This resulted in greater focus on farm management (especially business planning) and trade skills required to maintain a consistent professional business relationship between women dairy producers and Aarong Dairy through respective chilling plants. The evidence of change from project evaluation (Datassist and CARE 2016) are as follows:

- Milk Production per cow (cross-breed) rose by 2.74 times
- Income rose by 15%
- Market Linkage was measured by Milk selling pattern – Selling directly to company rose to ~50% while selling to milk collectors halved to 7.8%. In addition, selling to other actors (neighbors, Open market and sweet shops) all increased, demonstrating a wider customer base for dairy farmers indicating stronger business.
- Women dairy farmers control their income: Women acquiring cattle with their own income rose from 26% to 43%.

These dairy farmers were often the first women in their family or community to be involved in any business, thus required additional training on basic business skills which larger, usually male owned dairy producers did not need. Thus, as operations commenced periodic knowledge exchange sessions between dairy farmers and company management tweaked the business terms and conditions, greatly improving operational efficiency of the Dairy Hub Model.

Build-sustain-divest: SDVC was designed with resources allocated for data collection, reporting and other KM activities with the focused aim of helping Aarong Dairy answer the key question of what aspects of Dairy Hub Model should they invest in, sustain afterwards or divest from. The success of the model not only depended on social benefit of including small women dairy producers in supply chain; but also in being a commercially profitable venture, a good business strategy that others would adapt regardless of whether they are concerned with generating social benefit or not. This balance of social and business benefit was successfully maintained as seen by the following:

- The clear success of the Dairy Hub Model and using DFT is that PRAN (largest fresh dairy company now) also adopted similar model with DFT within the year of project's end. There are 100+ local importers who have DFT machines in their portfolio indicating the industry has adopted it as one way of maintaining supply chain and procurement of fresh milk (Tradeford, undated).

- The private sector partner, Aarong dairy, grew rapidly to account for 30% of nationally packaged dairy products market sourcing through 108 chilling centers from 28,000 dairy farmers and employing 14,000+ employees. Within project duration the participation of small women dairy producers grew from 2% to 55% and are now the majority producer in their supply chain.

Lessons learned and recommendations

Choosing the right private sector partner is a crucial aspect of successful KM collaboration. The company's ability to adopt and scale successful solution must be matched by its willingness to adopt gender inclusive approach. Aarong dairy is a for-profit subsidiary of BRAC, which is the world's largest NGO with the core mandate of unlocking economic and social potential of empowered women. The gender inclusive approach is ingrained into the organization's principle and thinking. This allowed the partnership and knowledge exchanges to occur with minimal problems. It was also critical to maintain business intent of both Aarong and communities which is where the information systems, knowledge flow, adaptive management and community engagement played a role to help evolving the business viability of the intervention. When

tweaking the model, it is essential to check whether the model remains profitable being gender inclusive. Working with poor and marginalized women farmers must make business sense or the model would not last beyond project.

Knowledge is ineffective without action. KM in private sector engagement has evolved from traditional project monitoring & evaluation. It goes beyond reporting on what is happening to investigate why and how for adaptive measures during project, rather than waiting till the end for final evaluation. Consequently, investments in KM was made throughout lifecycle of the project, synced with relevant stages in KM cycle with the goal of assisting Aarong Dairy to decide which aspects of Dairy Hub Model to build upon, which to sustain and what to divest from. These targeted investments created the space for informed and involved partnership with private sector actor, greatly increasing post-project sustainability of SDVC.

Case 2: AESA – Knowledge Brokering for financial inclusion

The USAID Agricultural Extension Support Activity (AESA) was a 5-year project working to enhance the agricultural extension services to 110,000 farmers in Southwest Bangladesh by working with 1,000 government extension agents, local NGOs and financial service providers. The farmers were identified via lowest in Well-being Category (White 2008) owning 0.2-1 hectare land. As part of AESA project, CARE formed multi-party partnership with local NGOs and Bank Asia to launch 'A-card' – cash-less financial product with lower interest rate and long repayment period, designed exclusively for small holder women farmers.

KM objectives and success

KM was an essential component across all objectives, particularly in enhancing access to and utilization of agricultural extension services by smallholder women farmers, expanding and integrating ICT to increase access to agricultural market information, knowledge and technologies and in strengthening capacity of extension service agents to respond needs of smallholder farmers especially women farmers. Marginalized populations in poverty cannot get access to formal banking as they do not have sufficient assets to provide as collateral, among other disadvantages. Despite being the world leader in microfinance, Bangladesh still sees huge gender inequalities in access to finance. Even when women can get loans, only 13% of women are able to exercise control over the use of loans (Singh, 2018). Thus, a better system of financial access is required. Particularly for A-card, CARE, with Dhaka Ahsania Mission (DAM), served as knowledge broker and facilitator between smallholder farmers, local Microfinance Institutions (MFIs)/NGOs, agri-input sellers and formal banking institution (Bank Asia). This entailed the following knowledge brokering activities:

Collect: The banking industry of Bangladesh is rapidly growing for decades and highly competitive. Companies like Bank Asia, in order to expand their market opened Agent Banking services (small banking branches in remote corners of the country). They are able to provide lower interest rates compared to microfinance loans (who charge 25%-30% on average) with more flexible payment terms. However, their understanding of smallholder women farmers is limited due to lack of exposure and gaining that understanding would be too expensive compared to the gains. At the same time, traditional gender and social norms, mobility restrictions, inability to own family land, limited financial decision making authorities at household levels combined with lack of reorganization baised women's significant contribution to the agro-economy in the country. They are unable to design accessible financial products for them as risk factors of bad loans cannot be correctly gauged and also gendered differences in loan requirement, use and engagement. That is the valuable knowledge and insight that CARE brought in based on its decades of work with communities. CARE helped to identify most viable women candidates from among their 110,000 farmers' database. Project provided individual farmer's profile: agriculture production cycles, financial acumen, extensive records of income and profitability as well as gendered consumer behavior understanding of women farmers as potential customers – enabling Bank Asia to select best candidates most likely for loan repayment.

Use: For any loan product, the crucial factors are interest rate and repayment schedule. By reducing risk of bad loans, Bank Asia could feasibly provide lowest possible interest rate (10%) which was half to a third of the microfinance loan rate available in the market. The repayment schedules were customized according to farmers' agriculture production cycle, with substantial grace period of six months – made possible by detail farmer profile provided by CARE.

There was additional challenge for women farmers, as due to social restrictions on mobility and interactions between men and women, women farmers do not interact directly with retailers (almost all-male), usually working through their spouse. They also have no interaction with technologies like A-Card. Thus, along with loan terms, in-depth profiling of women farmers guided the loan disbursement method and retailer interactions, which became a part of retailer on-boarding.

Enrich: One of the crucial terms of A-Card was to have the loans be disbursed through NFC-Enabled digital cards, akin to credit card, which could only be used to purchase agriculture inputs (Seed, fertilizer, pesticide etc). This was much more complex and capital intensive than a simple cash loan. However, CARE Bangladesh was adamant on this factor because the cashless loan increased women's control over money. Because women have little control of money and assets, cash loans are often taken away by male members of the household (parent/spouse) for

their own purposes. To convince banks to adopt this more costly model, CARE was able to demonstrate that cash loans might be easier to disburse, but are less likely to be repaid on time in full as the person profiled (women farmers) would not be the person using the loan (her spouse/male member of HH). In addition, despite high penetration of mobile telecommunication and growth of ICT, women have limited access to it, due to patriarchal barriers. With a gender gap of 34% in mobile phone ownership and 62% in Internet usage, gender remains a significant barrier to connectivity in Bangladesh (Hernandez 2019). Thus the technology adoption had to be on the retailers' side and not on smallholder women farmers. These are some of the specific gendered insights which informed the product design to be customized to characteristics and needs of impact group – increasing A-Card's adoption and probability of success.

Share and assess: Going cashless meant developing a network of agri-input sellers where A-Card could be used. Just like the small farmers, Bank Asia had no experience of working with small shops selling agriculture inputs like seed, fertilizer etc. Here, CARE used its knowledge on local agri-economy to identify shops best suited to serve the chosen women farmers. These retailers were on-boarded onto this new technology, a knowledge transfer task that NGOs like CARE can deliver due to their intersectional understanding of banking systems and smallholder agri-business. The solution was mutually beneficial. Retailers, who provide goods on credit (With higher interest and strict payback terms) receive payment instantly from Bank Asia and the bank has a new customer base able to access other products as necessary over time. These retailers also had to be sensitized to the customers being women farmers and how to responsive to gendered needs – thus ensuring initial interactions of women farmers with A-card retailers goes well.

Piloting innovative models is always a challenging task as parties involved often have to step beyond their usual expertise, naturally resulting in mistakes and challenges associated with experimentation. From the aforementioned SDVC project, CARE learned the importance of assigning roles to organizations according to their expertise to maximize chance of success. From in-depth knowledge of rural smallholder agro-economy, it was decided that while Bank Asia will disburse the loan, its collection has to be done through local MFIs and NGOs which have decades of experience in running loan schemes. This was a form of knowledge brokering where CARE carried out business matchmaking services according to needs of the model. This not only meant better loan management and repayments, but also greater risk sharing as Bank Asia shouldered only 10% of the risk of loan default (MFIs/NGOs takes the rest) while taking only 10% of the profit. Since Bank Asia's goal is to initially penetrate the market and learn how to manage this new group of clients, they were ready to forego profits. This allowed the large scale of the pilot. CARE's role did not end with starting the pilot, but throughout all three parties collectively tracked the loan taking women farmers to ensure they have a smooth transaction

process and are able to use the agri-inputs as intended to increase chance of successful harvest and consequently successful loan repayment.

Driving this performance tracking was robust KM system of monitoring, evaluation, advocacy and learning (MEAL) with joint studies and ICT-enabled dashboards accessible by private sector, banks and CARE. This included A-card website and dynamic progress assessments facilitating management of A-card program. While the loan terms remained constant, the management of A-card program and terms of interaction between the 4 parties: CARE, MFIs, Bank Asia, Retailers and Women farmers, were constantly tweaked in periodic meetings to improve the relationship underpinning the successful pilot of A-Card.

The success of this iterative process was seen during its evaluation (Mahalder et al 2018):

- During the pilot stage A-card receivers showed 100% repayment rate, production increased by 5.5%%, with production cost increasing by 4% (purchasing quality inputs) and revenue increasing by 15%. Thus, A-card farmers' income has increased by 14% meaning USD250 in additional profit in 6 months.
- Total savings with MFIs are at Tk. 100,000 (USD1300) with many saving for the first time. Without control over income or resources, savings were not viable for women farmers before. However, particularly for informal savings group, poor women have a general propensity to save that is stronger than men's propensity (Hernandez 2019). Thus, although not part of A-Card program initially, these women farmers started group savings with Bank Asia, creating another avenue for interaction to build future banking relationships. These changes were readily accepted by all parties due to their conviction in profiling of poor women farmers and their business network along with evidence-based understanding of gendered needs of customers.

Build-invest-divest: The project invested in developing detailed operational guidelines with stakeholders on each aspect of the model, like on-boarding retailers, gathering customer feedback, booklets on various agriculture businesses like beef fattening, dairy, aquaculture, training banking agents to disburse and collect repayment of loans etc. This was done so that post-project Bank Asia, DAM, MFIs and local NGOs can carry on the roles carried out by CARE post-project.

A major aspect of this knowledge transfer was for Bank Asia the understanding of smallholder women farmers and their gendered needs along with financial needs. The customer feedback was not only on loan terms but also their interaction with other actors, especially banking agents on disbursing and repayment of loans, who are used to all-male clientele. It was important for

CARE that all parties have similar level of customer profiling of women farmers or the pilot might derail to become another financial product for mostly male farmers. Thus customer feedback from women farmers shaped interactions of local banking agents and input retailers to be more gender responsive.

Bank Asia has committed to local procurement of A-card production along with machine readers for further expansion. Their current goals are to reach 50,000 users by 2021. Similarly, DAM continued its partnership with Bank Asia in expanding its network of Agent Banking. RSDA one of the local MFIs worked in to promote A-card completely on their own with Bank Asia to include further 2000 farmers. For Bank Asia, they aim to have half their users be women, while DAM and RSDA, who already have a large base of women farmers using MFIs, aim to shift towards A-card due to its better repayment rate and ensuring ownership and control by women. Their continued investment behind A-card is validation of the accuracy in profiling of women farmers and their business network, underpinning the design and implementation of the pilot.

Syngenta, among the largest agro-input companies in Bangladesh and the world, signed an agreement which would open their extensive network of licensed retailers to be included. They aim to provide smartphones to selected retailers to reach 1000 new A-card holding poor farmers. Syngenta has committed to larger portfolio in livestock feed and mixed seed packs for homestead gardening, both of which are traditionally female-centric activities. Thus, their investment behind A-Card is another validation of the quality of customer profiling and gendered insights into working with female smallholder farmers, who remain the biggest untapped market for agro-based companies.

Lessons learned and recommendations

Information dictates innovation's success: The quality of information on profiling of poor women farmers and their business network (retailers, MFIs, buyers etc) dictates the quality of decision making regarding product design and operations. It was specific accurate profiling, which lead to accurate selection of loan candidates which led to the high repayment rates.

Bridging the digital and gendered divide: The key challenge to executing A-card model was the digitization of loans to be cashless. Smartphone usage among retailers is very low and extensive capacity building and knowledge transfer needed to occur for the system to get up and running. Similarly, while fully understanding the benefits of cashless business transaction, women farmers also needed to shift mindsets to accept loans responsibility without having the cash in physical form. In addition, women farmers need to face the additional burden of societal judgement as they would need to travel to market and directly interact with retailers (mostly

male). Focusing only on the digital divide aspects would eventually lead to mostly male farmer clientele and/or women farmers sending their spouse – which eventually defeats the whole purpose of going cashless. Thus, through knowledge brokering it is important to keep gendered aspects in focus alongside business priorities. In this sense, CARE's role as knowledge broker was to essentially remind the business benefits of working with women which mostly-male clientele of Bank Asia can regress away from due to comfort with status quo.

Understanding limitations for adaptive management: One key aspect of KM in A-Card was identifying what it *cannot* do. Thus, initially, it focused on established livelihoods like rice and bull fattening. Although immediate needs arose for farmers in other areas like Aquaculture, the project exercised caution in developing a stable operating model first. KM is crucial in these actions of strategic prioritization and planning. Also, although the aim of A-Card was to shift up the women farmers from microfinance loans, knowledge and learning exchanges with A-card receivers revealed some cash loan is still required for paying day-labors wages in farming – meaning overlapping loans would still exist. Consequently, the banking agents and MFIs were trained to look at comprehensive loan repayment load for the farmer, not just for A-Card.

KM practices of CARE in market-based solutions

The aforementioned experiences informed CARE's approach to engaging private sector in understanding socio-economic barriers of gendered norms that systematically limit women's ability to do business, while quantifying their potential as economic actors and valued assets to private sector. When the knowledge exchange begins with a gender lens, so does the eventual solutions that arise eventually with collaboration. Given below are the KM principles of engaging private sector for business solutions inclusive of women.

Co-creating solutions

KM activities and exchanges are at the heart of co-creating solutions and managing the knowledge as part of adaptive management processes. Iterative approach, adapting to market realities and needs of poor women farmers and creating a sense of mutual. Market-based solutions are highly prioritized in development sector and transitioning towards sustainable solutions and impact at scale. However, mindsets differ, so to be effective, it is necessary to have mutual exchange of knowledge for action.

A market accepting of women requires private sector companies and CARE to bring together their respective knowledge and experiences to produce solutions that are profitable and inclusive. This requires both quantitative business data and qualitative information on attitudes, behaviors,

mindsets, social norms etc to be combined so that communities and private sector can achieve mutual understanding and mutual perspective shifts, required for a sustainable business relationship.

Not CSR but business partnership

Private sector engagement in development work is often defined as Corporate Social Responsibility (CSR), indicating private companies work with NGOs out of a sense of social responsibility and general welfare. CARE's principles of engagement posit that NGOs are business partners with private sector counterparts it is a partnership for mutual benefit. Pro-poor inclusive business is a profitable venture, working with poor women is not for charity, it's good for business. NGOs expertise, reach and understanding of the poor and marginalized communities is an asset for Private companies to reduce risk and CAC (Customer Acquisition Cost) required to penetrate market with relevant products and services. While these companies can provide the scale and resource to create beneficial impact at scale that sustains beyond project duration.

Impact at scale and sustainability

Co-designing and co-implementing pilot of innovative products or services is the most promising form of engagement for all parties involved. Aarong Dairy greatly expanded its Dairy Hub Model and was adopted by others like PRAN and Rangpur Dairy not out of sense of social responsibility but because it proved to strengthen the business. Similar exchanges are seen in A-Card with the service expanding to other projects of CARE as well as continued partnership between DAM and Bank Asia. This required investment in collecting, sharing, and applying data that created solutions for poor women farmers. This investment is something that private sector companies do not make on their own, as it requires operations, skills, and presence in these communities that they do not have in-house. Those are the exact resources CARE has access with their experience, enabling the iNGO to provide information in an applicable manner for private sector actors.

Whether profit motives or social responsibility, patriarchal notions on economy means most market actors would be males used to working only with males. Consequently, economic interventions disproportionately favor males as they hold the control over economic activities. CARE's approach to knowledge brokering focuses on gendered interactions in among market actors with women farmers and larger community, creating space for women to both engage in economic activities and benefit from them equitably.

The oversimplified understanding that private sector is only profit-driven while NGOs are purely charity-based no longer holds true. Banks are actively pursuing remote smallholder women

farmers to be their client while most local NGOs have microfinancing institutions (MFIs) wing. Aarong dairy – the second largest dairy company is a spin-off from development projects of BRAC – the world's largest NGO. In this rich dynamic environment, iNGOs like CARE represent interests of economically and socially marginalized people like smallholder women in agriculture – to ensure that the engagement mutually beneficial, and those benefits reach equitably across genders. As knowledge brokers, the role of CARE remains to establish the poor and women as viable business actors, either as supplier or client. Like any partnership, mutual benefits may start it, but only mutual understanding of mindsets will sustain it. Thus, CARE focuses on gendered differences having equal focus with business related differences.

Importance of tacit knowledge

The private sector is also adapting to the development mindset of inclusive business. Private Sector Actors are gaining capacity in the role of trainers to beneficiaries & retailers/agents, a role usually left to NGOs. They may become a viable alternative, expanding our choices and scope in partnerships. However, despite various detailed written guidelines, private sector representatives struggle to work with marginalized women farmers. Effective knowledge management results in behavior change, and for that to happen it requires understanding of approaching and engaging women farmers. This tacit knowledge, of not just communicating information, but *how* it is imparted is still a skillsets of NGOs. Transferring that skill through co-implementation is equally important. Thus, Bank Asia's banking agents work directly with MFIs and local NGOs while during SDVC project, the project staff essential ran the DFT machines, chilling plant and collection points, accompanied by Aarong company representatives, to acquire that tacit knowledge of working with women dairy producers.

Partnerships for inclusive market systems:

The process of our partnership may be summarized as:

Profiling: Instead of expensive Market Research, NGOs like CARE provide in-depth quantitative and qualitative understanding of poor and marginalized, gleaned from decades of experience and baseline data, on who they are (*demographic*), how they think (*psychographic*), and what it would take for them to purchase inclusive products or services (*consumer behaviour/purchasing behaviour*). Even more valuable, CARE provides a ready database to choose from among thousands (or millions) of poor and marginalized women with whom they interact regularly through their projects.

Co-design: The projects provide testing ground for these products to be refined (like for A-card it was Interest rate, loan amount range limits, repayment schedule etc) CARE answers these questions from perspective of poor and marginalized while Bank Asia measures business

feasibility of needs - somewhere in between lies the product or service features which will be successful. The honest exchange of explicit and tacit knowledge is essential for sustainable solutions

Co-manage: NGOs have human resources honed to work with economically disadvantaged and marginalized with special focus on women. Private sector companies have relatively wider distribution networks for its products/services. However, due to lack of exposure, private companies do not have sufficient expert personnel to reach out to poor and marginalized population, especially women. As general economic participation of women is low, the private sector company's frontline employees are unlikely to have extensive interaction with women and business clients, whether buyer or supplier. Thus, they would require their teams to be trained and new. management teams set up team to rollout pilot . Instead, partnering with NGOs allows them to capitalize on each other's knowledge assets. Like to introduce A-Card to communities of women farmers, Bank Asia were able to use CARE's frontline project staff, community leaders or volunteers essentially as banking agents. This meant Bank Asia had a tailored team with in-depth localized gendered experience with poor and marginalized women farmers. Sharing resources and expertise lowers cost of implementation on all parties involved.

Scaling: Finally, through products like Intervention Guideline, if Bank Asia or DAM wants to scale up A-card in other areas on their own, they know exactly the costs, who to reach, how to reach and whom to use as agents. This facilitates their scaling while multiplying impact (for us) creating lasting change beyond projects. As the importance of tacit knowledge shows in A-Card, the intervention guideline alone is not enough, the people to people on-the-job skill transfer is equally important which often leads to failed scaling attempts post-project. Gendered differences in customer profiling for any product or service defines market interactions to build business relations. Private companies need not only data but the people skills to interact with this new customer/supplier.

KM in market systems approach: evolution and limitations

KM is still evolving in the development sector of Bangladesh, as is the approach of inclusive markets for women. Thus, KM practices keep changing from project to project. The agri-business environment is rapidly evolving, dynamic – and its role of KM to remain relevant and useful. KM is effective when it results in actions that improve efficiency, effectiveness, impact or sustainability of the project. There are limitations on applying KM in development work. Markets are driven by profits, tangible attributable benefits. KM lacks that, making it difficult to measure. Meaningful knowledge and learning needs systematic engagement capturing both tacit and explicit knowledge which requires investment. The proof is often seen only at the end, incongruent with quick-wins and iterative visible results-driven decisions associated with private

sector thinking. As such, more evidence is required for KM to become a standard practice in inclusive market approach for women.

Conclusions

Business solutions to reduce poverty is an important aspect of development. However, due to low economic participation of women, these benefits of decreased poverty are not gender equitable – women do not benefit from these solutions in the same way as men do. Private sector has limited understanding of working with women as market actors and supply chain where NGOs excel. A successful pilot of including women farmers into business requires sharing quantitative evidence of mutual benefit as well as tacit skills of working with women farmers by market actors who have dealt with almost exclusively male clients. The process is iterative and multi-stakeholder requiring NGOs like CARE to play role as knowledge broker. The above cases offer examples of how private sector, NGO and communities can work together for mutual equitable benefits. The gap in knowledge, understanding and interaction between companies and poor women farmers are significant. The potential benefit of bridging that gap is bigger whether economic or social, making KM a worthy KM for both private sector actors and NGOs. By working together to find solutions that promote more inclusive businesses and gender equality, both businesses and women can benefit.

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[i]This image was previously available here:
https://www2.deloitte.com/lu/en/pages/strategy/solutions/knowledgemanagement.html#.U05CiGcayc1

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The private sector in knowledge processes and partnerships for food and nutrition security in the Global South: a case study from the Dutch Food and Business Applied Research Fund programme

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Based on a recent outlook on the food and nutrition security, the zero-hunger goal is unlikely to be achieved by 2030. To improve the situation, there is a need for transformational changes not only by producing high-quality knowledge and innovations on food and nutrition security but also by ensuring their uptake and upscaling. On this challenge, the private sector is increasingly seen to play a critical role. However, the underlying factors and dynamics supporting such private sector mainstreaming in knowledge processes and partnerships are poorly known. This paper, therefore, contributes to the knowledge gap and learns from the Dutch Food and Business Applied Research Fund (ARF) programme to explore the role the private sector has played. We found that for-profit actors can bring value to research processes and knowledge development. However, the collaborations come with challenges related to goals and interests, implementation approach, and marketing strategies. The outcomes of such collaborations may be mixed and, in some cases, lead to results that are not inclusive for the most food insecure. Partnerships that include the private sector should be cognizant of the possible challenges and proactively define approaches that leverage the private sector to add value to food and nutrition security outcomes.

Keywords: For-profit actors; agribusiness; inclusive business; smallholders; agriculture; food systems; knowledge co-creation; knowledge management; Sustainable Development Goals

Introduction

The world is one decade to the deadline of the 2030 agenda for Sustainable Development Goals (SDGs). The SDG 2 focusing on food by seeking to 'end hunger, achieve food security and improved nutrition and promote sustainable agriculture' is one of the most pressing goals, which unfortunately is unlikely to be achieved. The number of undernourished people

worldwide has been on the rise these last five years, with more than 820 million people having insufficient food for a healthy life (Willett et al. 2019). Underperforming in achieving the zero-hunger goal is linked to the complexity of food and nutrition security (FNS), which is intrinsically related to many other SDGs (Brooks 2016). Therefore, transformation at scale and more inclusive efforts are required from policymakers, researchers, communities, and the private sector.

Of particular interest, partnerships between publicly funded research and the private sector – defined here as for-profit agricultural companies – are increasingly promoted for several reasons. One reason is that public agricultural research, although still relevant, is shrinking with both national governments and aid agencies reducing their commitment to agricultural research and development, in both the North and the South (Jin and Huffman 2016, Adesina 2019). Consequently, the private sector is increasingly assuming a more significant role in developing improved technologies for food and agriculture, with increased private agricultural research and development spending (Fuglie 2016, Pray and Fuglie 2015, Stads and Sène 2019), although more slowly in Africa (Stads and Sène 2019). Another reason is that private enterprises have the capacities to move research outputs from labs to markets and scale up innovations, for example, through commercialization (Boehlje 2004, Gallardo et al. 2016). Therefore, the private sector mainstreaming into agricultural research and related knowledge processes has become more relevant.

Consequently, there has been a large amount of research on FNS, which generates insights, technologies, and innovative solutions that could reduce hunger (Ajayi et al. 2018, Spielman et al. 2010). Now, there is an urgency for not only high-quality knowledge on FNS but also and, more importantly, the capacity to use and value this knowledge effectively (Fanzo et al. 2018), with the private sector as a critical channel. However, the underlying factors and dynamics supporting the partnership with and the mainstreaming of the private sector in knowledge processes are under-researched (Cummings et al. 2019), although essential for increased application and scaling up of FNS research. Specifically, what functions do for-profit private agricultural companies play in knowledge processes and partnerships with researchers? What challenges do stakeholders encounter in such collaborations? How do private agricultural companies support scaling up of innovations and technologies that are created in these knowledge processes and partnerships? These are relevant questions that require in-depth exploration. Our paper, therefore, contributes to the knowledge gap and learns from the Netherlands Food & Business Applied Research Fund (ARF) programme to explore the role of the private sector in knowledge processes and partnerships. It does so by highlighting reflections of ARF researchers and from the funding body on experiences of working in the ARF programme.

Since 2014, the ARF programme has developed an innovative framework for knowledge co-creation, acquisition, and utilization among researchers, the public sector, practitioners, and

the private sector. 45 transdisciplinary research projects have been implemented and have integrated scientific and non-scientific knowledge, experiences, and practices in problem-solving. Examples of projects include, among others, the development of a hybrid solar-gas mango dryer in Ghana; fortification of cereals with milk protein in Uganda; breeding spider plant (a local vegetable) for West and East African markets, development of a smartphone app to improve irrigation in Bangladesh, and formulating a local infant food in Benin (NWO accessed, 2020). The programme, therefore, provides the research with a valuable case to improve understanding of how the private sector is involved in generating, co-constructing, and scaling knowledge to advance food and nutrition security.

The paper is structured into five sections. Section 2 presents the ARF programme, its objective, approach, and foci of interest. Section 3 presents the role of for-profit actors in knowledge partnerships and processes on three aspects: relevance of private sector involvement in food and nutrition security interventions, operational challenges of collaborating with the private sector, and role of the private sector in upscaling agricultural research and innovations. Section 4 discusses the findings and their implications. Section 5 concludes and shares perspectives.

The Applied Research Fund (ARF) programme

The Applied Research Fund (ARF) programme aimed to promote research-supported innovations that contribute to food security and related business needs. The objectives of the ARF were to contribute to development and innovation. Rooting innovation in local and regional problems, socioeconomic conditions, and capabilities, was a prerequisite for optimizing the potential for meaningful impact. ARF provided grants only for high-quality applied research projects that were practitioner-driven and evolved in a process of co-creation with different knowledge partners.

Research projects funded through ARF tackled challenges related to food and nutrition security and private sector development in the 15 partner countries of Dutch development cooperation within the Multi-Annual Strategic Plans (MASPs) of the Dutch embassies (Figure 1). The projects stemmed from the knowledge and innovation needs of farmers, practitioners, and policymakers. The research-driven innovations supported new tools and technologies for food and nutrition security that should ultimately benefit the world's most vulnerable people, especially women and children. ARF was funded by the Dutch Ministry of Foreign Affairs, managed by WOTRO Science for Global Development, which is part of the Netherlands Organisation for Scientific Research (NWO), and supported by the Food & Business Knowledge Platform.

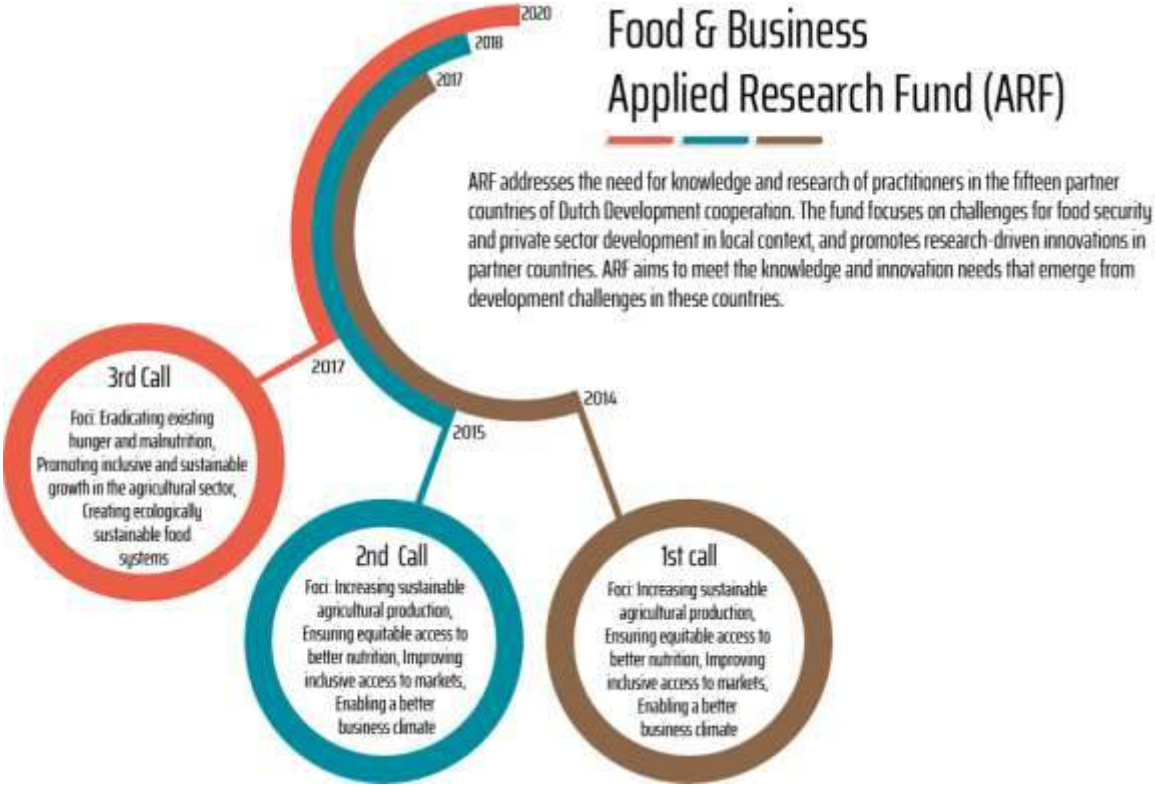

Figure 1. Description of the ARF programme, timeline and foci of calls for proposals (NWO-WOTRO 2020)

An innovation in itself

The ARF was a pioneering funding instrument because it focused on innovation through applied research, and a specific composition of multi-stakeholder consortia drove these innovations. In addition to research organisations, the consortia consisted of practitioners organisations from both the profit, not-for-profit, and public sector. In this way, different kinds of skills and knowledge – academic, practitioner, tacit, and community knowledge – were brought together to address the food security challenges (Figure 2). Notably, an innovation of the programme was that a practitioner organisation from the partner country was leading the project team to ensure local relevance and uptake. This set up of fostering a practitioner organization to lead the research process was groundbreaking compared to the common practice where research projects are led by research organizations. Corinne Lamain, coordinator of Food & Business Research at WOTRO Science for Global Development (WOTRO) underlines that ARF was the first instrument in which this set-up was applied. Placing the coordination of the research in the hands of local practitioners was based on the assumption that this would lead to demand-driven research in which the focus is on issues that were indeed encountered by local producers, consumers, and other food system actors. As such, the knowledge that was produced in the projects would be usable by those same groups.

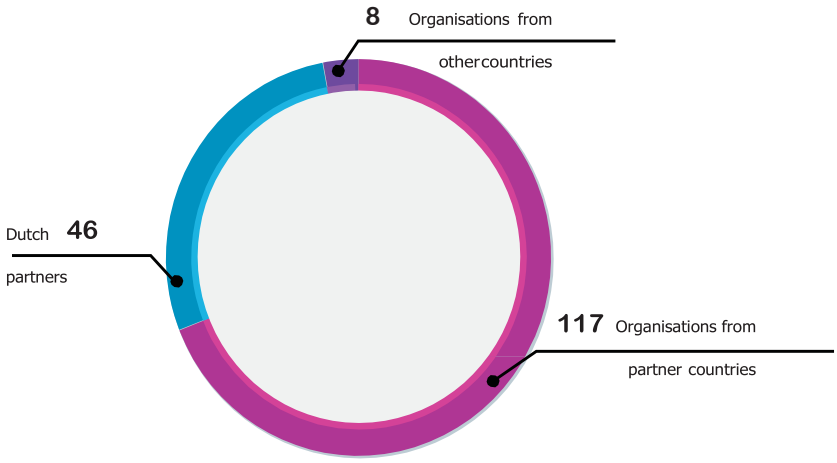

Figure 2. Diversity of partners within ARF projects consortia (NWO-WOTRO 2020)

The practitioners that were in the lead of research consortia were based in the Global South. Within ARF, practitioners organisations might include any type of organisation other than research or higher education organisations that represent a group of people actively engaged in food security, both 1) private for-profit enterprises and related support organisations, as well as 2) private non-profit organisations, such as non-governmental organisations, cooperatives, unions, civil society organisations, et cetera, and 3) public organisations such as governmental departments of line ministries or local governments, extension services (Figure 3). However, in the framework of this paper, the private sector is understood as private for-profit enterprises. The paper focuses on the collaboration within the research projects between researchers and private sector representatives.

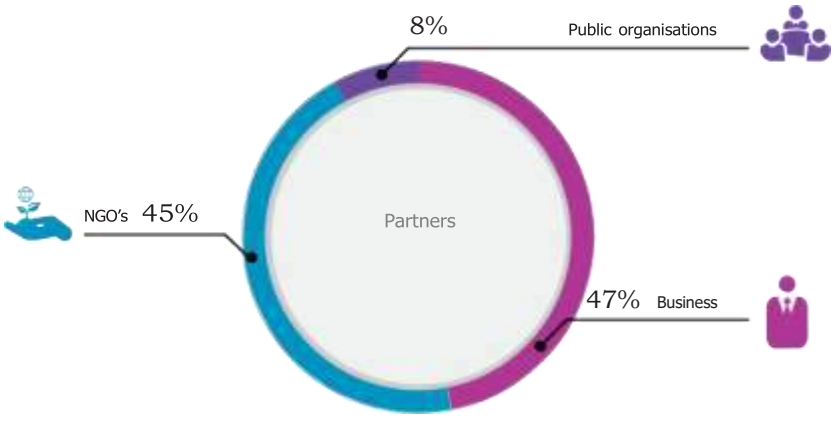

Figure 3. Practitioners organisations within ARF programme (NWO-WOTRO 2020)

Co-creation by transdisciplinary consortia was the driving force behind the ARF approach. Co-creation within ARF was understood as 'a form of cooperation in research where different parties (researchers and stakeholders) in the knowledge process (demand and supply) interact and engage in joint learning to define problems, formulate possible solutions, design the research, conduct the research, assess the results and to translate these into new practices and products' (NWO-WOTRO, 2017). Integrating practitioners' and scientific knowledge in joint research was also an innovation of the programme that helped enhance the potential for the research contributing to impact. Notably, the engagement of stakeholders was initiated during research proposal development (co-design) and continued through research execution (co-creation). This is facilitated by the joint formulation of a Theory of Change, in which the problem statement and desired impact are presented, as well as the expected Pathways to Impact that specifies how actors need to be engaged in the research project. This exercise places the project within its wider system and gives insights into complex change processes. The Theory of Change and Impact Pathways are continuously revisited during research execution in order to test assumptions underlying the expected change processes (Mayne, 2015). This approach was paired with a strong focus on research uptake, which referred to all activities that contributed to the use of research results. The use of results was vital, as the ARF's objective was to fund innovations that have a tangible and positive impact on people's food and nutrition security. Simultaneously, research uptake also aimed to improve the policy and business environment (system change). Corinne Lamain recalls how, for many of the research consortia, assigning a budget to activities for stakeholder engagement, communication, capacity strengthening, and monitoring and evaluation was fairly new. At the onset of the programme, research consortia were brought together in ARF regional workshops, in which the ARF approach, including Research Uptake, was introduced. ARF researchers that attended the workshops were positive about learning and working with the approach.

Policy context

ARF was one of two funding instruments that were part of the Food & Business Research (F&BR) programme funded by the Dutch government and managed by NWO-WOTRO. While the ARF supported relatively short research for innovation in the fifteen Dutch partner countries, the Global Challenges Programme (GCP) supported more in-depth research on emerging global topics and challenges in food and nutrition security. The F&BR programme was part of the Food & Business Knowledge Agenda, through which the Dutch Ministry of Foreign Affairs supported the global quest to develop and implement effective ways of enhancing food and nutrition security in cooperation with the private sector. The Food & Business Knowledge Platform (F&BKP) was established in 2013 to support the knowledge management activities on this knowledge agenda. The F&BKP was one of five knowledge platforms focusing on priority issues for Dutch development cooperation. Information and

news on the ARF and GCP projects were kept updated at the F&BKP website, which also showcased the platform's other areas of work.

The priorities of the Dutch government's 2011 policy on global food security were the main impetus behind the first two ARF calls. In a Letter to Parliament in 2014, the government changed its focus to three priorities, which together determined the scope of the third ARF call: eradicate existing hunger and malnutrition; promote inclusive and sustainable growth in the agricultural sector and create ecologically sustainable food systems. The earlier priority of enabling a better business climate was incorporated as a cross-cutting focus. The ARF projects were also aligned with the Multi-Annual Strategic Plans of the Dutch embassies in the respective partner countries. ARF and GCP were linked to the Dutch Top Sectors Agri & Food and Horticulture & Propagation Materials.

Methodology

The study followed a three-pronged approach to achieve its objective. First, we performed a desk-review to identify, collect, and include relevant studies. The desk-review surveyed the literature to learn from previous research on the role of the private sector in knowledge partnerships. Next, we made a screening of the consortia[i] of the ARF-funded research projects to select those that included *for-profit* actors. The selection allowed documents gathering. The gathering collected all knowledge products (findings factsheets, scientific publications, policy brief) that were released on each project's website[ii]. Then, we read their content and looked at whether gathered documents, in any extent, described or analyzed collaborations or outcomes related to the involvement of their for-profit partners. Out of 58, only 04 documents provided relevant information regarding the topic of our study, and were, thereby, included for data extraction. Besides, three key documents related to the ARF programme and relevant for our topic were added: a brochure published at the midterm of the ARF programme that highlighted partners perspectives on knowledge co-creation by multi-stakeholder consortia, the ARF final evaluation report, and an outcome synthesis study on the private sector perspective on how research can enhance business opportunities that serve marginalized farmers and consumers.

Second, an interview was conducted with the authors of the outcome synthesis study on the private sector perspective. As they recently conducted nine informative semi-structured interviews with ARF projects, we decided to discuss with them and learn from their exchanges with field partners. The purpose of the interview was to understand better our reading of documents gathered and to augment our analysis in this paper. Our interview focused on the contributions of private sector actors in the knowledge processes. The following questions guided the interview: Why such actors were involved in the research projects? How did they contribute in practice to the research? How did they benefit from the

research? What operational challenges partners were encountered during collaborations, and how they dealt with that? How did private sector actors contribute to upscaling? How knowledge partnerships could better involve private sector actors in knowledge processes. Besides, we collected the perspectives of the authors about their involvement in research projects or the funding body.

Last, we read each document and extracted data and information related to our focus questions on the role of private sector actors in knowledge processes and partnerships: successes of ARF projects in mobilizing and innovating with the private sector, operational challenges, and lessons learned on mainstreaming the private sector in knowledge processes, and role of the private sector in upscaling agricultural research and innovations. Next, we processed and summarized the information and data collected through document analysis. Afterwards, we discussed the results and compared them with academic knowledge that dealt with the role of for-profit actors in knowledge generation and research uptake.

Results

Private sector in the knowledge process of the ARF programme

The creation of transdisciplinary research consortia in which actors from the private sector collaborate with researchers, non-governmental organisations (NGOs) and/or government agencies aims to support the co-creation of knowledge. This process entails defining the problems, formulating possible solutions, designing the research, conducting the research and assessing the results, as well as translating these into new practices and products. As Frejus Thoto, from ACED, a practitioner organization involved in the ARF research programme has indicated, transdisciplinary research championed by practitioners and private sector (not researchers) is a game-changer in how action research is conducted in the food and nutrition security sector. In the experience of ACED, this innovative research design has ensured that the consortium is focused on needs that are effectively expressed by those who are supposed to 'consume' the research products and innovations.

Of the 45 ARF-funded research projects, about 15 mobilized actors from private sector defined here as for-profit agricultural enterprises. These actors were specialized in various types of businesses. Their activities encompassed food consumption/fortification products, seeds production, pest management products, weather and ICT-based extension products, crops/fruits/vegetables/fish production, and solar drying technology. They were in Africa (Kenya, Ghana, Benin, Uganda) and Asia (Indonesia, Bangladesh). The research projects they partnered with were working on the development of a specific innovation or technology including, for example, the development of a rodenticide for rice post-harvest losses, the development of sesame and plantain seeds, and the design of a weather censoring station.

Some actors reported that the development of these innovations and technologies could not have been possible without funding a research phase (Rajapandian N.R. et al. 2015, Alacho F.O. et al. 2015, Komen 2019, Etu-Bonde 2019, NWO-WOTRO 2017). Learning from the midterm ARF booklet, a private company in Bangladesh affirmed:

> *[…] we would never be able to invest in this level of resources for a technical innovation. We recognize that there are great social needs in the agricultural sector, but from a purely commercial perspective it would not have been feasible for us to hire the expertise to develop an IT solution like this from scratch.*

The contribution of for-profit actors in the research process was substantial to make sure they master the innovation processes. They actively contributed skills to the design and test of the efficiency of the products or participated in field experiments that developed new varieties, a new solar drying machine, or tailored weather forecast, among others. Private companies also played the role of brokers between researchers and end-users. This brokering role has improved connections of research with users to fine-tune the research process and outputs to the demands of the market. A related testimony was made by a Ghanaian company below (NWO-WOTRO 2017):

> *During the development phase of the weather stations, it was our role as an enterprise to ask the farmers for their feedback on how the technology could be improved. If they said: 'the daily weather forecast is useful, but what we really want is a monthly forecast', we would tell the researchers, 'this is what the customer wants, how soon can we have it?'*

Private sector actors were also more active in research uptake such as training of farmers and entrepreneurs, experience sharing, demonstrations, and extension meetings to build first contacts with farmers, entrepreneurs, and consumers that form a market of early adopters. Their benefit was, then, clear: packaging a ready market-driven innovation for commercialization. For instance, in Uganda, the affordable food cereals project showed that waterproof packaging of the newly developed infant food formula contributed to its longer shelf-life but making the product available to customers took a while because of delays in the certification process. However, thanks to the private partner's persistence and cooperation, the new infant food was officially certified (de Winter and Lammers 2020), thereby ready for the market.

Operational benefits and challenges and lessons learned on mainstreaming the private sector in knowledge processes

The collaboration of different types of knowledge in the research consortia came with benefits and challenges. The synthesis study paper presents, for example, how the collaboration with the private sector helped identify new use functions for acacia trees that were introduced in

Northern Ethiopia as part of an ARF project. When the consortium realized they needed fresh views on the project objectives, a representative of a particle board factory was included in the advisory board. They saw an opportunity for the functioning of the tree beyond land restoration, the purpose for which the research consortium had introduced the trees in the region. Through this engagement, farmers were introduced to new value chains, offering them an opportunity to increase their income. It was by the involvement of different types of knowledge and interests that the benefits of the project were enhanced.

Although the co-creation approach indeed generated new knowledge and innovations in some instances, the collaboration process within consortia with private sector actors was not always easy. Some operational challenges were faced. First, there were challenges concerning goals and interests (Etu-Bonde 2019, NWO-WOTRO 2017, Syspons 2019). As the ARF evaluation pointed out:

> *[…] it can be challenging to bridge the interests of consortium members for whom research is more important, and those for whom action and application is more relevant. Thus, even though the collaboration between various partners can lead to synergies, the assumption that the interests and world views of partners will align through collaboration cannot always be confirmed.* (Syspons 2019).

Indeed, although the project's goals of societal and policy relevance were shared, partners had different expectations about the actual results of the research (e.g. short-term success versus long-term benefits and impact) as well as different interests. From the perspectives of business actors involved in research projects, entrepreneurs are driven by commercial motives constantly protecting property rights or patenting innovations, while the researchers' primary incentive is to enhance understanding and accordingly publish about research findings and innovation in peer-reviewed journals (NWO-WOTRO 2017).

Furthermore, researchers sometimes are confined in theories, while business actors are looking for practical outputs for businesses. To overcome this challenge, a research consortium in Ghana convened to an agreement to allocate commercial shares during the commercialization phase to all partners. Also, there were cultural, professional, and institutional differences that influenced the priorities of partners and made difficult the collaborations. In some settings, close prior personal relationships between the partners helped to facilitate communication, reduce tensions, and bridge the gap between differences in perceptions and interests (Etu-Bonde 2019).

There were also challenges related to the approaches used to market the research outputs of projects. These challenges arise from the need to reconcile the business perspective of the private enterprises that seek commercial viability and researchers and development partners who are more sensitive to the affordability of research outputs and innovations to poor actors.

For instance, the fact that cashew seedlings were given away for free to farmers in Uganda was identified by the business partner of the project as one of the reasons for the shallow survival rate of these seedlings. From their perspective, the success of it taking off at the farm level could not rely on the good-will of farmers. Hence, collaboration was challenged when for-profit actors opposed marketing perspectives from researchers and suggested that there could be increased ownership if the farmers had paid even a small amount for the seedlings.

Experience in ARF underlines, as Corinne Lamain explains, that research innovations are often directed to consumers that are in the middle and higher classes while the ultimate target groups of ARF are the world's most vulnerable people, especially low-income women and children. Those groups cannot afford producing, or consuming, the products that are directed at formalised (inter)national markets. Related to this, a key conclusion from the external evaluation of ARF was that:

> [..] *a "trade-off" exists between the two ARF programme objectives of fostering private sector development and supporting food insecure target groups. ARF projects that aim to establish a business model do not consistently focus their efforts on vulnerable target groups that suffer under food insecurity in the partner countries, but on those who can contribute to the business effort (which mostly are farmers with sufficient income and education).* (Syspons 2019).

A specific example of a project that addressed this challenge was a project in Benin led by a private enterprise in partnership with the University of Abomey-Calavi. The project aimed to produce and commercialize local infant foods. It successfully brought to market the first certified infant flour that is made of locally available animal and plant resources. To increase the affordability of the product for poor households, the project adopted a two-pronged marketing approach. First, it released the product in ready-made format targeting consumers in the formal, mostly urban markets in Benin. Also, it made publicly available the formulas so that poor households can make the infant flour themselves (Rampa et al. 2020). The development of such inclusive marketing approaches was not straightforward. It resulted from intense discussions within the research consortium as the private enterprise did not see it as a sustainable approach, from a business point of view.

Although collaboration can lead to challenges, it was nevertheless vital to maintaining an open dialogue on how to proceed, while never losing sight of the initial goals. An example from the statement of a Ghanaian company was shown below (NWO-WOTRO 2017).

> *The last two years have been a crash course in working in partnerships. Despite all the hiccups and differences, I strongly believe that multi-stakeholder partnerships are the way to go. The collaboration has made our innovation much more solid. Our company has learned a lot: a team from Delft University in the Netherlands and*

> *scientists from Kwame Nkrumah University of Science and Technology in Ghana joined us for a 3-day brainstorming workshop in Accra. We worked together on creating one-page business models that define our value propositions and activities for opportunities we identified for the weather station project. We have learned about exploring new opportunities and thinking big. The whole experience has put us in a different space.*

Role of the private sector in upscaling agricultural research and innovations

The ARF experience is quite recent and still ongoing; the last projects will complete in 2020. Thus, it may be too early to discuss the experience of upscaling its outcomes, extensively. However, the programme has undertaken multi-stakeholder consultations to discuss scaling up opportunities. In this section, we discuss some of the outcomes of these consultations but also present some early scaling up experiences by showcasing the role played by the private sector. Participants to the ARF consortia acknowledged that successful upscaling of innovations generated by the project is contingent upon a strong collaboration among stakeholders, including the researchers, the public sector, practitioners, and the private sector. For example, participants at the scaling up workshop organized for ARF consortia in November 2019 in Benin, highlighted that scaling up agricultural innovations does not just happen; it needs to be planned and managed by all stakeholders right from the start of the project. Researchers should collaborate with the private sector to understand market needs, and the government and legislative should ensure there is an enabling business environment that facilitates (e.g. subsidies, infrastructure, tax reduction). If these requirements are already observed in the design stage of the project, the private sector can effectively support upscaling of innovations. Corinne Lamain considers this a vital lesson for funding schemes as well: an exit strategy that is defined with the consortium partners should already be part of the research proposal.

In some cases, the private sector has played a crucial role in upscaling by ensuring the sustainability of innovations through the development of new or adjusted business models and capacity building. To do that, the ARF projects integrated their research into existing value chains, and private sector actors turned innovations into business cases. They ensured, first, that capacitated human resources and processes were incorporated in their activities to further support target groups, their customers. Next, they ensured that innovations were accessible and could be used by the target groups and thereby integrated the developed innovations into the local supply chains. For example, the solar drying project in Ghana developed a dryer produced and maintained with local materials at the design stage. In this way, the project could ensure that the dryer could be maintained and potentially rebuilt using local materials (F&BKP 2019).

Similarly, the private company involved in the weather monitoring project in Ghana integrated the innovation into their business value proposition to continue offering them to

farmers at scale. Donald Houessou, from ACED, who was a member of a consortium that aimed to improve income, food, and nutrition security in urban areas through allotment gardens in Benin, shared a similar experience. The consortium mainstreamed an upscaling strategy from the start of the project that supports capacity building of allotment gardens participants who could transform their activity into a commercial venture. Before the end of the project, the allotment gardens had secured farming contracts and were able to cover their operating costs without any further support from the project. The success story of these pilot gardens paved the way for scaling the project results, and a decision-making tool was developed to ease the scaling process for local governments.

Furthermore, the ARF projects found potential avenues for securing investment from private actors to scale up innovations. Projects that developed technologies that could be turned into business ideas were particularly prone to secure the continued investment of the private partner for upscaling. Thus, including a requirement for private sector involvement was a successful strategy for upscaling research innovations. For example, in the mango drying project in Ghana, one of the project goals was to develop a financially viable method of drying mangoes. When the financial profitability was shown in the project, the consortium partners decided to form a joint business around their solar dryer that could sustain the financing of the innovation and its upscaling at the end of the project funding (Syspons 2019). The private company is expected to lead the business.

Discussion

The ARF programme offers interesting case studies that enabled us to learn from the contributions of for-profit actors in knowledge processes and partnerships that aim to improve food and nutrition security. Indeed, by using a document analysis methodology, our study reported the experience of the ARF programme on how the private sector is involved in generating, co-constructing, and scaling knowledge to advance food and nutrition security. First, we found that in the ARF consortia, business partners worked closely together with universities and other research organisations. Most of them were involved in research projects that aimed to develop a specific innovation or technology. Although it is a new terrain, they got involved in the research processes; two reasons may justify such interest: 1) the business cases that the innovations offer at the end of the research process, and 2) the initial investments offered by the ARF programme that extend their research and development capabilities. Collaboration with private companies is also beneficial to researchers as it brings to research teams the business mindset that can be useful to the co-creation process.

Next, although co-creation was vital in driving innovation, there were however, some difficulties that challenged the knowledge processes and partnerships during the research. However, our study focused only on those that relate to collaborations with the for-profit

private sector. We found that three main challenges are encountered by research consortia while working with businesses. First, there are challenges concerning goals and interests that occur, usually, in the beginning and during the knowledge process and where priorities may differ, depending on the expectations of researchers or businesses. Second, there are collaboration challenges that occur during the research process and may oppose partners on approaches and ways to go. For instance, while researchers focus on the developed solution, business partners want to exploit a commercially viable innovation which, in most cases, may require additional work from researchers to fine-tune innovations to the need of the market and, hence, may cause frictions. Third, some challenges appear at the stage of marketing of the innovations. Here, collaborations are challenged when for-profit actors point out the need to use a purely commercial approach that targets consumers with sufficient resources. Simultaneously, researchers and practitioners prefer approaches more inclusive of resource-poor consumers, in line with the objectives of the research programme.

By looking at the reasons behind such challenges, we learnt that cultural, professional, and institutional differences between researchers and businesses are the main reasons that influence the priorities of partners. Cultural differences influence the mindsets of partners and the kind of knowledge that they consider useful, relevant, and valuable in the knowledge processes. However, the experience learns that dealing with such challenges is difficult but requires to maintain an open dialogue on how to proceed while never losing sight of the initial goals. In some settings, close prior personal relationships between partners may facilitate communication, reduce tensions, and bridge the gap between differences in perceptions and interests. Therefore, new knowledge partnerships must be cognizant of such challenges and invest in building up their relationships and mutual understandings.

Furthermore, the study found that, in the ARF programme, agricultural businesses can support the upscaling of research findings and innovations. They could play this role by ensuring innovations are tuned to the demands of the market and subsequently developing new business models or adjusting existing ones. Besides, for-profit partners can further invest resources to package a ready innovation for commercialization or integrate innovations into the local supply chains, thereby boosting its utilization. The previous examples show that the implication of private sector actors in knowledge processes may have a positive impact on upscaling innovations that help improve food security in the world. In their studies on the marketing of innovations, Boehlje (2004), Gallardo et al. (2016), Reardon et al. (2019) confirmed the potential role of private companies in upscaling agricultural innovations. Hence, there is a clear indication that private sector actors may bridge the limitation of the public sector to address the SDG2.

Despite the potential of the private sector, there are tensions as to whether this positively impacts the most vulnerable food insecure groups. For example, Ros-Tonen et al. (2019) argued that there are possibilities of adverse incorporation and exclusion in value chains

participation, and therefore, will never be inclusive to all. The evidence from the ARF programme, tends to show that upscaling processes driven by private companies mostly are in favour of households in the middle and higher classes. From a business angle, this satisfies the objectives of the private companies that include profit-making from customer segments who can pay for the innovations. However, from a developmental perspective, it is a problem as programmes like the ARF target the world's most vulnerable people, especially low-income women and children. The implication is that such programmes should clearly and explicitly disclose what we coined here as '*exclusiveness tolerance*'. That means the acceptable trade-offs between business growth and social costs should be known early in the knowledge process. In this way, all parties are aware of what the results will look like and how the business interests and developmental objectives should be combined, or rather addressed in separate efforts. This could lead to research programmes aiming at enhancing inclusive approaches on the one hand. On the other hand, this may lead to programmes that refrain from developing agricultural innovations to improve food and nutrition security of the poor with established agricultural companies that do not display and prove any commitment towards inclusive business models.

Moreover, by capitalizing on knowledge from the F&BR programme including ARF projects, about how research can enhance business opportunities that serve marginalized farmers and consumers, de Winter and Lammers (2020) found that, beyond businesses, research, local context, consumers, and policy environment are four main elements that can also facilitate upscaling. Although innovations can be purposely disruptive, challenging existing approaches and beliefs to improve the status quo, risk-averse groups, such as small-scale farmers, may not be easily inclined to welcome disruptions unless hard evidence and assurances were given about their feasibility or profitability. In this context, the active involvement of researchers may lend more credibility to the results. Next, local contexts and consumers are essential factors in developing innovations and determining the possibility of scaling innovations. Last, the policy environment is instrumental in upscaling innovations as supportive governments may create frameworks that foster efficient processing of certification requests and benefit smallholders' access to the market. The partnership between private partners and researchers may prove a valuable tool as partners could benefit from each other's unique qualifications and networks in the field.

Altogether, the findings suggest that the private sector is increasingly an important actor that should be involved in knowledge processes and partnerships. Their involvement may be more critical when it comes to designing and upscaling a product or technology for the market. This lesson is useful for practitioners and policymakers to design and support interventions aiming at developing solutions facing the agricultural sector. The paper may also serve scholars that need insights on how to actively involve private sector actors in the research process. For instance, indications regarding challenges that were faced by research consortia within the ARF programme provide a pathway to anticipate difficulties in future research partnerships.

Conclusions

The paper explored the role of the private sector in knowledge processes and partnerships that intend to improve food and nutrition security to help advance the achievement of the SDG 2. Findings indicated that for-profit actors could be an essential partner in generating and upscaling agricultural innovations. In the Global South, wherein public agricultural research is low, the private sector should be encouraged to participate more actively in knowledge creation processes, especially where it can critically contribute and add value to developing innovations. However, integrating the private sector in research raises three main challenges in terms of goals and interests, implementation approach, and marketing strategies. These challenges may be overcome if the roles, responsibilities, and interests of each stakeholder are well understood and translated into agreement and terms of references.

While acknowledging its relevance, the role of the private sector should not be overestimated or considered as a panacea for knowledge production that aims to benefit food and nutrition security for resource-poor groups. The performance of the private sector in knowledge processes and partnerships for food and nutrition security is contingent on the context of the collaboration and actions of other actors such as the government, researchers, and non-profit organizations. Finally, beyond knowledge generation, the process of knowledge sharing and upscaling is nonlinear and context-dependent. Hence the performance of the private sector in upscaling knowledge and technology may be challenged by some risks with unintended effects. Such risks should be known and controlled to ensure effective uptake of innovations.

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[i] All 45 ARF-funded projects and their consortia can be located on the Netherlands Organisation for Scientific Research (NWO) website https://www.nwo.nl/en/research-and-results/programmes/food+%26+business+research/ARF+research+projects

[ii] Each project was referenced on NWO website (cited above) and on the Food & Business Knowledge Platform (FBKP) website https://knowledge4food.net/research-projects/applied-research-fund/

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The private sector as the 'unusual suspect' in knowledge brokering for international sustainable development: a critical review

Suzanne N. Kiwanuka, Sarah Cummings, Barbara Regeer

Although the private sector's engagement in sustainable international development is receiving increasing emphasis, its role in knowledge brokering has probably not yet received enough attention. Drawing on the Glegg and Hoens' (2016) meta-framework of knowledge brokering we analysed the role of the private sector in knowledge brokering in Europe and Africa, based on the literature. Of the 702 records identified from 5 bibliographic databases, 13 studies, representing 44 case studies and two surveys were included. The private sector's roles are versatile, extending beyond connecting research evidence to potential users, to connecting researchers to funding opportunities and to other researchers, and to hosting platforms for collaborative research and policy making. The private sector actively invests resources to facilitate knowledge uptake, however this is to a large extent driven by self-interest. Perceived self-interests remain a barrier to knowledge brokering with the private sector not always being a trusted partner. Our results demonstrate that 'lobbying and advocacy' should be an additional role included in the meta framework of knowledge brokering.

Keywords: private sector; knowledge brokering; international development; literature review; Africa; Europe

Introduction

One of the key challenges facing the field of international sustainable development is knowledge brokering between the domains of practice, policy and research and across organizations in order to improve the evidence-base for development policymaking, programmes and projects. Research on knowledge brokering is increasingly justified because its role in harnessing lessons from the millennium development goals agenda, fostering knowledge sharing and collaboration across organizations is deemed a critical step towards the achievement of Agenda 2030 and the Sustainable Development Goals (SDGs) (UN, 2015). In 2016, the UN Joint Inspection Unit, a key body which aims to improve the effectiveness of the whole UN apparatus, emphasized the importance of knowledge within the SDG process, arguing that knowledge has the potential to break down silos and is a natural integrating factor for all stakeholders in the implementation of Agenda 2030 (Dumitriu, 2016).

Within this context, the private sector is also receiving increasing attention in international development with Agenda 2030 and the SDGs calling upon 'all businesses to apply their creativity and innovation to solving sustainable development challenges' (UN, 2015). The private sector has been 'foregrounded' in the SDGs in which '… businesses, governments and civil society actors are equally called upon to pursue a more sustainable path forward' (Scheyvens et al., 2016: 372). There is greater emphasis on the private sector because of its purported potential to 'scale up the interventions that have proven most effective; to extend these approaches to new fields and unreached people' (UK Department for International Development, 2011), to employ its considerable financial, technical and technological resources (WRI/IIED, 2013) and to contribute to the effectiveness and efficiency of aid (Horn-Phathanothai, 2013; WRI/IIED, 2013). However, this greater focus on the private sector within the framework of the SDGs ignores its contested nature. According to Spangenberg (2017: 316):

> Business is treated as a per se benevolent actor for the public good, instead of a market based, profit seeking undertaking; the objectives and targets include no criteria to distinguish between a positive and a negative role of business for sustainable development (the fact that many sustainability problems have been caused by business activities is not mentioned at all).

Despite this background, there is a recognition within the international development community that the private sector is an increasingly important partner in knowledge brokering and that more needs to be known about it (Cummings et al., 2019). This is also reflected in policy with, for example, a recent consultation on Dutch knowledge policy indicating 'the role and influence of the private sector should receive more attention in research' (Wigboldus et al., 2019: 9). Although there has been an enormous amount of research on knowledge brokering practices within the public sector domain in international development, such research does not generally include the private sector. For example, the Research and Policy in Development (RAPID) group at the Overseas Development Institute (ODI), a prominent British think tank in international development, has published more than 1007 publications on 'research and policy in development' since its formation in 2003[1], focusing on the links between research, policy and practice. Through such research initiatives, focusing on knowledge brokering with their varying terminologies (knowledge intermediaries, knowledge translation, knowledge co-creation), many insights have been developed. Unfortunately research on knowledge brokering practices within the public sector, the private sector has received much less explicit attention than other actors and can be seen as an 'unusual suspect' in knowledge brokering for international development.

To review past evidence of knowledge brokering with the private sector, a critical interpretive synthesis was undertaken to examine the scientific literature on the private sector in

[1] Data collected 21 February 2019

knowledge brokering within multi-stakeholder partnerships in the field of international development. Although many partnerships also include an element of knowledge brokering, this paper focuses on partnerships with a specific focus on knowledge brokering, rather than on knowledge brokering as side process. It was intended to inform the empirical part of the project which will collect qualitative data from knowledge platforms in Uganda and Europe, as well as from global online networks on experiences of working with the private sector in knowledge brokering.

Knowledge brokering for international development: an overview of theories and frameworks

The field of sustainable development is populated by international organizations, such as the UN organizations, the bilateral organizations, such as the Department for International Development (DFID) in the UK and the US Agency for International Development (USAID), as well as international and national non-governmental organizations (iNGOs and NGOs) which are concerned with development. While development is defined as: 'the synergy among millions of innovative initiatives people take every day in their local societies, generating new and more effective ways of producing, trading, and managing their resources and their institutions. The work of policymakers and development agencies influences the success of those initiatives, by shaping or undermining those efforts' (Ferreira, 2009: 99). Knowledge which is relevant to development includes global, national and local knowledge. Knowledge brokering therefore encapsulates inter organizational as well as cross-domain knowledge integration and co-creation (Cummings et al., 2019). Knowledge brokers therefore act span the interface between knowledge generators and users by networking and advocating for a cause on the basis of the expertise they possess in their domain, their legitimacy and credibility (Jackson-Bowers et al., 2006: 2).

Knowledge sharing and collaboration across sectors, both formal and informal platforms has been argued to be a critical step towards the achievement of SDGs and is enshrined in SDG 17: 'Strengthen the means of implementation and revitalize the global partnership for sustainable development' (UN, 2015). Knowledge brokering allows isolated or unconnected actors to share information and resources and to interact economically, politically and socially (Stovel and Shaw, 2012). Typically, a 'broker moves among groups fostering collaborative processes, with the aim of generating new "brokered" knowledge that is more robust and readily applicable within its intended local context' (Glegg and Hoens, 2016). The broker may connect separate areas of a network socially, economically or politically, and therefore he/she is the only one to access both valued information and resources from different areas of the network (Stovel et al., 2011).

Frameworks and models of knowledge brokering

The dynamics of knowledge brokering processes have been studied extensively in global literature. A number of theories and frameworks have been put forward to describe this process. Haworth-Brockman (2016: Unpaginated) influenced by others, considers that knowledge brokering is 'messy and complicated, which can also be understood to mean that what is translated, how it is translated, by whom, when and why … depends' . In addition, knowledge brokering has many synonyms where 'Terms such as knowledge brokering, knowledge translating, knowledge exchange, and knowledge mobilization are all used extensively, but the different terminology has hidden the fact that the actual functions they describe are all systemically related to each other' (Shaxson et al., 2012:2).

Given this complexity and the many different models, frameworks and terminologies, the Glegg and Hoens (2016) meta-framework was identified, based on a synthesis of five different frameworks and models:

1. The Knowledge to Action Cycle which is premised on the belief that knowledge generation and the implementation of existing and new solutions is a complex cyclical process (Graham et al., 2006). In order for this process to run efficiently, it is imperative to remain vigilant to problems at each stage of the knowledge generation, synthesis and exchange process, and to document the problems in reports, discussion forums, clinical logs or research papers, so that they can be identified by researchers and other experts who can promptly address them.

2. Developed by the National Collaborating Centre for Methods and Tools (NCCMT), Canada, (2011), the Promoting Action on Research Implementation in Health Services (PARiHS) framework provides a perspective on the factors that are important when implementing research into practice. The focus of this framework on facilitation makes this a good framework for relationship-based knowledge brokering. In summary, the PARiHS framework posits that different types of evidence both tacit and explicit, including; research evidence, practitioner experience, community preferences and experiences, and local information, need to be considered. This evidence needs to be embedded into decision making through a process of negotiation and shared understanding with careful consideration of contextual issues.

3. The Fernandez and Gould (1994) framework explicitly addresses the influences of power in relationships. It expands upon existing concepts of brokerage to include contextual factors stemming from the properties of the knowledge brokering actors. From these, it proposes a fivefold typology of brokerage roles.

4. Diffusion of innovations is not a model or framework but a theory, originally developed by Rogers (2003). As expressed in this theory, innovation, communication channels, time, and social system are the four key components of the diffusion of innovations.

5. The K* or K Star spectrum framework (Shaxson et al., 2012) describes a continuum of functions and processes of knowledge brokering, ranging from dissemination to co-creation and innovation.

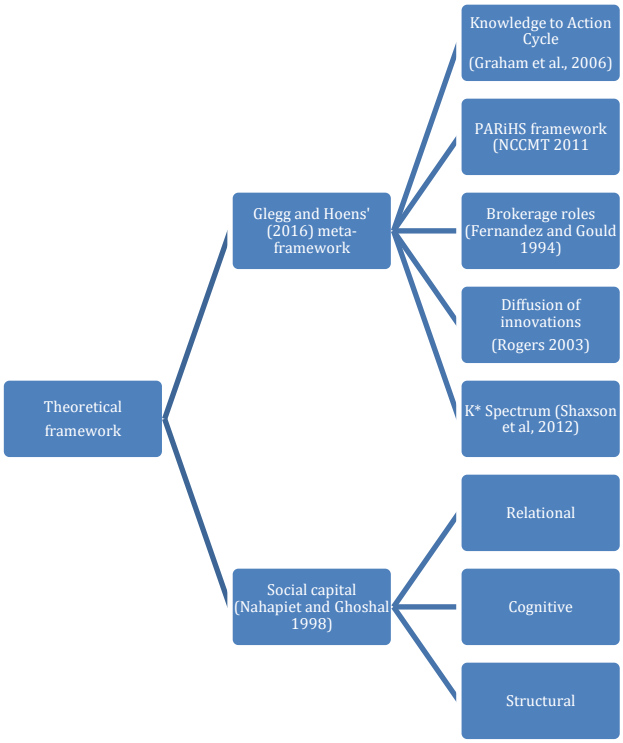

Figure 1: Conceptual provenance of the theoretical framework (Authors, derived from Glegg and Hoens 2016 and Nahapiet and Ghoshal 1998).

Based on these models and frameworks, Glegg and Hoens (2016) identify 5 different knowledge brokering roles in their meta-framework: information manager; connecting agent; capacity builder; facilitator; and evaluator. Each of these roles is described by their functions producing a total of 16 functions. Although the role of capacity builder does not appear in any of the five models/theories reviewed above, Glegg and Hoens (2016) included it as additional role because it is an important function of knowledge brokering. Capacity building, also known as capacity development and capabilities, is a stalwart of international development (see, for example, Merino and de los Ríos Carmenado, 2012) which makes its inclusion particularly appropriate here. This synthesis employed the Glegg and Hoens (2016) meta framework(see figure 1) , which describes five roles of a knowledge broker because the role

of the private sector as a knowledge broker and its participation.in in these activities has not been well documented.

We reviewed existing literature on the private sector's knowledge brokering activities through this lens to capture roles, prcesses facilitators and challenges in order to glean lessons to inform Agenda 2030. In addition, we considered the role played by social capital by focusing on cognitive (what), relational (who) and structural (how) aspects of knowledge brokering.

Methods

Critical Interpretive Synthesis (CIS), a method for conducting a systematic literature review, was used to interrogate selected articles that focus on the role of the private sector in knowledge brokering. The CIS method was selected because it facilitates the analysis of complex, diverse bodies of literature (Dixon-Woods et al., 2006; Barnett-Page and Thomas, 2009; Taylor et al., 2009; Gysels et al., 2012; Kazimierczak et al., 2013; Ako-Arrey et al., 2015), it is particularly suitable for the analysis of qualitative literature (Egger et al., 1997; Charmaz, 2006; Dixon-Woods et al., 2006), allows the development of new concepts and theories because it offers a 'flexible, iterative, dynamic, and explorative approach' (Ako-Arrey et al., 2015).

The process of conducting the CIS included; conducting a comprehensive literature search, applying predetermined eligibility criteria to screen and retrieve articles, and data extraction and analysis. The private sector activities were assessed using the lens of theoretical framework developed in the previous section. Specifically, the study selected a CIS approach because it allows for interpretive, in-depth exploration of literature and employs the qualitative principle of saturation while searching data.

It should be noted that the CIS methodology does not aim to include an exhaustive number of papers but rather a comprehensive sampling frame of potentially relevant papers based on a given eligibility criteria (Entwistle et al., 2012; Markoulakis and Kirsh, 2013). Based on the included papers, the CIS methodology allowed us to iteratively interrogate the roles and practices of the private sector critically and interpretively based on our theoretical framework (Dixon-Woods et al., 2006).

Definition of concepts

The private sector for this work was defined as a segment of a national economy owned, controlled and managed by private individuals or enterprises rather than the government and run with the intention of making profit (Imaga, 2003; Osemeke, 2011) while knowledge brokering was defined as a set of activities and processes used to facilitate the exchange of knowledge (demand, supply, generation, facilitation and use). A knowledge broker was defined as the person, institution or organisation that connects separate areas of a network

socially, economically, or politically, by virtue of their access to both valued information and resources from different areas of the network (Stovel et al., 2011).

Search strategy

We searched five electronic databases, six websites and knowledge platforms, and undertook reference chaining. Given the nature of the review questions, our broad and flexible search included a broad sweep of studies around knowledge brokering in the private sector (Charmaz, 2006; Dixon-Woods et al., 2006; Ako-Arrey et al., 2015). In searching electronic databases, we initially drew on conventional systematic review methods to develop or search strategies which include the population, intervention, comparison and outcome. We piloted this search strategy across some electronic data bases and found it to be inappropriate because it yielded a large number of hits (7,000,000 million on Web of Science for instance) and applying a time limit resulted in only 11 hits putting us a greater risk of missing relevant papers. We therefore developed a more iterative strategy which varied across databases and used it to search electronic databases and websites.

The search strategy modified as follows, varied across different databases:

TS= (private sector OR business OR 'for profit' OR entrepreneur* OR small and medium enterprise* OR companies OR company OR 'public private partnership')
AND
TI= (knowledge OR information OR Evidence OR Research OR findings OR Data OR results
AND
TS= (broker* OR intermediary* OR platform OR network OR 'policy dialogue' OR sharing OR co-creation OR network OR boundary OR engagement OR forum OR groups OR advocacy OR think tank OR coalition OR partnership OR 'structural hole')

Only studies conducted in Europe or Africa where private sector knowledge brokering activities were specified and specific outcomes of knowledge brokering as the main role were reported. Searches were conducted till January 2018.

Screening, extraction and synthesis

All papers retrieved from our search (with the exception of Google Scholar) were uploaded onto reference manager for screening. Google Scholar hits were screened within the database and only 25 pages were screened. All duplicates were removed. The inclusion criterion was applied by both primary reviewers (SNK and SC). Papers describing the same intervention were treated as one entity in order to avoid 'double counting' of interventions that have multiple related outputs.

Data were extracted from all included papers using a standardized data extraction template developed by the team. For the first twenty percent of included papers, data were independently extracted by two of the primary reviewers for purposes of quality control and calibration. The rest of the included papers were divided evenly between the reviewers and data were extracted independently by two researchers.

Data synthesis was conducted by both first author and second author by identifying the codes and themes emerging from the included papers to identify private sector knowledge brokering roles and their functions, summarized the challenges and facilitators of knowledge brokering, then shared the findings with the third.

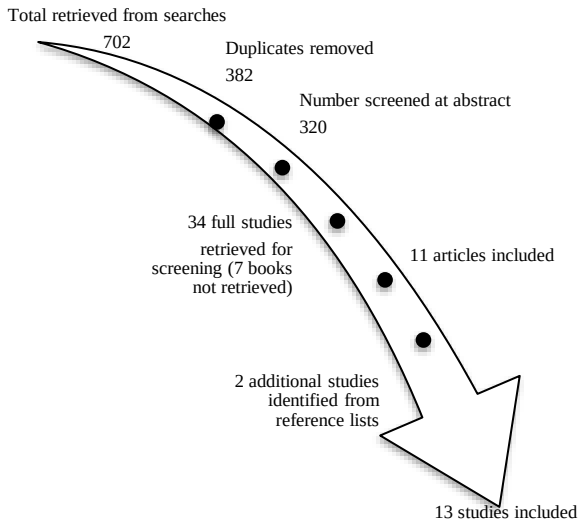

Figure 2: Flowchart of study selection

Results

Our sampling frame eventually totaled approximately 702 published records identified from our searches (see Figure2). Of the 320 articles screened at abstract level, 18 studies met our criteria. Of these 11 articles were retrieved but 7 books could not be retrieved. From the reference lists of the 11 articles two additional articles were found to meet our criteria making a total of 13 included articles. Figure 2 shows the studies excluded and included and why.

Of the thirteen studies included, nine were from Africa (Kenya South Africa, Uganda, Malawi, Zambia, Burkina Faso Ethiopia, Mali, Benin) and four were from Europe. Most of the studies were published only as far back as 2000 with the most recent published in 2017. The studies comprised a total of 44 case studies and two surveys. The number of case studies ranged from 29 case studies within a single paper to a single case study for several papers. The level of detail in the case studies varied greatly across the different papers with some providing a detailed description of private sector KB roles and others providing a summary. This synthesis is therefore not based on individual case studies but rather focuses on the overall perspectives communicated from each paper.

Cognitive component: private sector thematic areas and competences

The thematic areas covered by private sector brokering encompassed Agriculture, Mining, Health, Tourism, Security, Traffic, Environment, Land, Education and legislation. Specifically, the private sector in South Africa focused on disaster risk reduction and conservation of environment by commissioning research, funding and facilitating joint knowledge co-construction and production (Chikozho and Saruchera, 2015; Gysels et al., 2012; Sitas et al., 2016), while the agricultural private sectors in Europe and Netherlands focused on addressing malnutrition, connecting farmers and food small and medium enterprises (SMEs), fostering networks, and connecting farmers to hardware suppliers, funding sources and policy information (Sherrington, 2000; Van Kammen et al., 2006; Klerkx and Leeuwis, 2009; Dotti and Spithoven, 2017). The highest number of case studies were from Kenya cutting across biotechnology, security, agriculture, exports, manufacturers, mining, shipping real estate, tourism and health among others. Finally in Malawi, the focus was on advocacy, connecting agents to influence policy in sectors of agriculture and health (Hutchinson et al., 2011; Irwin and Githinji, 2016).

In Table 1, an overview is provided of the themes and geographical locations of the studies. For example, Mbadlanyana et al. (2011) has a continental focus, as does (Sherrington, 2000), while other cover multiple countries, such as the study by Hutchinson et al. (2011), or two countries, such as Van Kammen et al. (2006). We used an asterix to demonstrate the juxtaposition of theme and country. In the case of the environmental sector, we have broken it down into subsectors. More than one asterix indicates multiple studies. From this overview, we can draw a number of preliminary conclusions. First and not surprisingly, 13 studies are unable to give a complete and comparable geographical coverage. For example, South Africa is strongly represented with three studies, probably reflecting its relatively strong academic performance, while there are only three Francophone African countries included (Benin, Burkina Faso and Mali), probably a reflection that we covered only the English language literature. Second, the sectors of health, food and agriculture, nutrition and the environment are represented with multiple studies, while there were three non-sectoral studies which were focusing on think tanks and the knowledge economy more generally (See Table1).

Table 1: An overview by theme and country region

		Sectors									Studies
Region	Country	Health	Nutrition	Food and Agriculture	Environment					Non-sectoral	
					Climate change	Disaster risk reduction	Water	Forestry	Total environment		
Africa										*	Mbadlanyana et al. (2011)
East Africa	Ethiopia		*								Pelletier et al. (2018)
	Kenya[#]	*		*			*		*	*	Irwin and Githinji (2016)
	Malawi	*									Hutchinson et al. (2011)
	Uganda	*	*								Hutchinson et al. (2011), Pelletier et al. (2018)
	Zambia	*									Hutchinson et al. (2011)
	Region	**			*	*			**		Hare et al. (2014), van Kammen et al (2006)
Southern Africa	South Africa			*		*		*	**	*	Reyers et al. (2015), Sitas et al. (2016), Chikozho and Saruchera (2015)
West Africa	Benin			*							Moumouni and Labarthe (2012)
	Burkina Faso		*								Pelletier et al. (2018)
	Mali		*								Pelletier et al. (2018)
	Region	*									Hare et al. (2014)
Europe	Belgium			*	*				*		Dotti and Spithoven (2017)

	Netherlands	*		*							Klerkx and Leeuwis (2008), van Kammen et al (2006)
	Region									*	Sherrington (2000)

Relational component: roles and motivations

The private sector players covered in the included studies were diverse. They included business associations (Hare et al., 2014; Irwin and Githinji, 2016; Reyers et al., 2015; Sherrington, 2000), private universities and research organizations (Chikozho and Saruchera, 2015; Dotti and Spithoven, 2017; Hutchinson et al., 2011; Pelletier et al., 2018), Insurance companies (Reyers et al., 2015; Sitas et al., 2016), Lobbyists (Van Kammen et al., 2006) and those referred to as NGOs (Mbadlanyana et al, 2011). In some case studies multiple private sector players were mentioned but in only a few were their distinct roles distinguished (Chikozho and Saruchera, 2015; Dotti and Spithoven, 2017; Reyers et al., 2015; Sherrington, 2000).

The knowledge brokering roles and activities undertaken by the private sector players, including individuals as well as institutions, were analysed, endeavouring to identify the challenges they encountered in executing these roles. These roles were categorised according to the Glegg and Hoens (2016) model. The private sector played predominantly information and linking connector roles but also undertook capacity building and facilitator roles in some settings. A summary of these activities is provided in Figure 3 below.

In terms of the information role, the private sector was involved in the generation of research questions/ideas, highlighting evidence gaps through co-production, by conducting high quality research as well as harvesting it from research institutions, packaging evidence and disseminating it to users. But beyond providing research evidence, the information producer role included identifying and communicating opportunities for partnerships for funding and for fostering collaborations across their networks. Five studies indicated that knowledge brokering by the private sector helped in knowledge co-production to include developing knowledge products, and sharing of information (Chikozho and Saruchera, 2015; Dotti and Spithoven, 2017; Hare et al., 2014; Irwin and Githinji, 2016; Sitas et al., 2016). Private sector knowledge brokers generated evidence through conducting high quality research and two papers highlighted knowledge brokering helping evidence synthesis and policy analysis (Reyers et al., 2015; Van Kammen et al., 2006). This information producer role required the private sector to have personnel who are highly professional and competent, with the ability to quickly separate and package essential information from the bulk of evidence and to communicate appropriately and sometimes maintaining these professionals is costly (Reyers et al., 2015). Furthermore, in order to remain relevant, they need to be ahead of their clients

by anticipating their information needs. Therefore an "insider" strategy and relationships with stakeholders is required (Chikozho and Saruchera, 2015; Irwin and Githinji, 2016; Reyers et al., 2015).

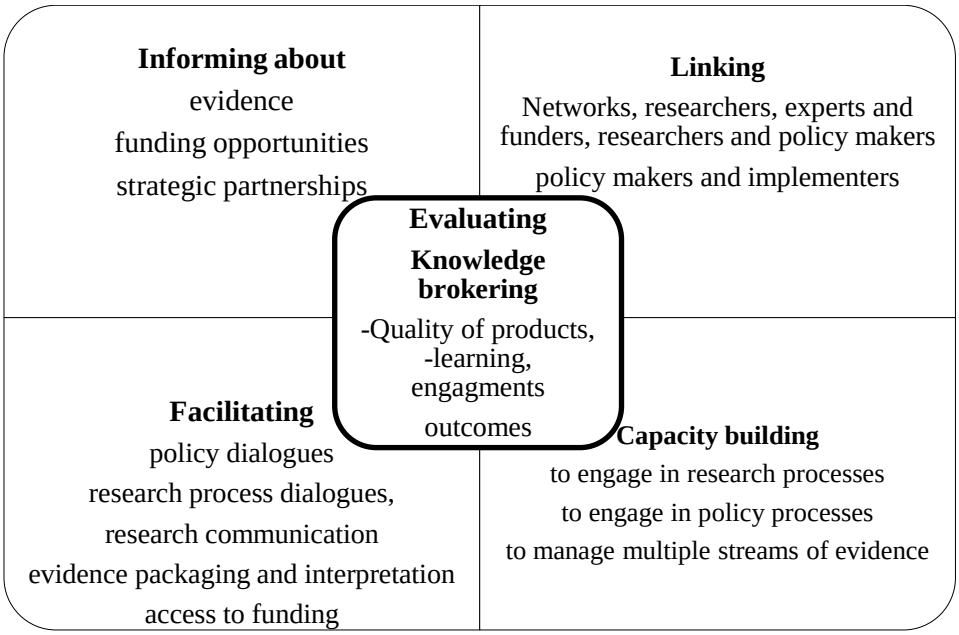

Figure 3: A summary of private sector roles in knowledge brokering

In terms of the linking connector role, the private sector acted by connecting critical stakeholders and networking them for strategic partnerships. For instance, implementers were linked with knowledge producer networks to disseminate information to actors and institutions at national and transnational levels (For example, institute for European environmental policy) (Chikozho and Saruchera, 2015; Reyers et al., 2015; Sitas et al., 2016). Private sector actors led the formation of new communities of practice and research networks, and they acted as bridges or mediators for connecting qualitative and quantitative models creating a better/common understanding of complex problems. The linking connector role also included connecting other knowledge brokers with research institutions for collaborative research and connecting experts to facilitate co-construction and coproduction of policy issues and evidence on best practices (Chikozho and Saruchera, 2015; Hutchinson et al., 2011; Moumouni and Labarthe, 2012). Private sector actors connected researchers to funders and to other organizations they can network with as well as to policy makers. In this way, they also influence funding decisions. In some instances, the differences in the pace of operations across different institutions was a source of challenge to getting multiple stakeholders move in unison towards agreed actions. However, instituting formal agreements enabled them to mitigate this challenge (Chikozho and Saruchera, 2015).

The capacity builder role encompassed activities related to didactic training, to enabling

changes in systems, processes and infrastructure to facilitate knowledge brokering. The private sector appeared to engage in capacity building infrequently. When they did engage in it, they mostly strengthened the capacity of target institutions to manage information by enhancing the quality of knowledge products available for decision making and strengthening platforms available for formal and informal conversations, small group meetings, workshops, conferences, emails (Hutchinson et al., 2011; Irwin and Githinji, 2016; Reyers et al., 2015; Sherrington, 2000; Van Kammen et al., 2006). Only two studies indicated that the private sector strengthening national and regional capacity for knowledge translation and dealing with information (Van Kammen et. al, 2006; Irwin and Githinji, 2016). Private sector actors acted as mediators, coordinating meetings/workshops, building alliances and managing disagreements, and converting conflict to collaboration. They created platforms of communication which enabled them to scan existing needs and opportunities, scope and filter by deducing who can best meet the need and how, and ultimately match making relevant individuals and institutions towards a set goal. However building capacities of multiple stakeholders with diverse backgrounds, competencies, pre-conceived solutions and in grained mental models provided its own challenges (Chikozho and Saruchera, 2015; Hare et al., 2014; Irwin and Githinji, 2016; Reyers et al., 2015; Sitas et al., 2016). Creating competence involved the private sector proactively investing in knowledge brokering by hiring professionals, seeking knowledge from credible sources, building strategic partnerships, facilitating productive dialogue and investing in communication systems, which are adapted to the needs of their audiences. This proactive approach gave them prominence, credibility and relevance to their different stakeholders as competent and responsive agencies. This competence was also underpinned by the private sector's ability to constantly evolve to meet the needs of its stakeholders in order for their contributions to be viewed as adding value.

The private sector facilitator role involved in the creation of implementation teams, sectoral working groups, and formal alliances and collaborations, as cited in three papers (Klerkx and Leeuwis, 2008; Pelletier et al., 2018; Reyers et al., 2015). The facilitator role also involved the creation of platforms for dialogues and learning among stakeholders to foster collaboration by arranging conferences and events. They also initiated the creation or reform of institutions at national or subnational levels, such as implementation teams, sector working groups and formal alliances. In summary, they facilitated convergence and commitment of stakeholders by enhancing the alignment of products, processes and players. This role was constrained by frequently not knowing which stakeholders to convene and what their needs and motivations were (Chikozho and Saruchera, 2015; Irwin and Githinji, 2016; Sitas et al., 2016). However in some cases the private sector was lauded for its ability to provide a neutral space for dialogue especially in instances where no obvious conflict of interest was perceived (Sherrington, 2000; Sitas et al., 2016). The private sector was facilitated in this role through its positioning within relevant networks as well as geographical location (Sherrington, 2000; Sitas et al., 2016).

The evaluator role of the private sector was infrequently mentioned. Within this domain, the knowledge brokering by the private sector included evaluating the strength of generated and solicited evidence (Chikozho and Saruchera, 2015; Dotti and Spithoven, 2017; Hare et al., 2014; Sitas et al., 2016), which ensured the credibility of the evidence they provided. They also evaluated the quality of engagements to identify preferred modes of interaction across stakeholders (Chikozho and Saruchera, 2015; Dotti and Spithoven, 2017; Hare et al., 2014; Sitas et al., 2016) as well as learning (Hare et al., 2014; Reyers et al., 2015; Sitas et al., 2016) and the outcome of the KB activities (Hare et al., 2014; Reyers et al., 2015; Sitas et al., 2016). This evaluation role was challenged by the fact that sometimes the inadequacy of funding and unsynchronized funding and implementation cycles limited the execution of agreed plans (Irwin and Githinji, 2016; Reyers et al., 2015; Sitas et al., 2016). Furthermore, none of the outcomes could be solely attributed to the private sector due to the multiple players involved (See Table 2).

Table 2: Summary of Private sector Knowledge brokering roles

Sub themes	Description	Authors
1. Information Producer		
Knowledge co production	Help in developing knowledge products, dissemination and sharing of information for advocacy, describe best practices, identify gaps and solution, through professional networks, social media and Think Tanks websites.	Irwin and Githinji (2016) Sitas et al. (2016) Chikozho and Saruchera (2015) Hare et al. (2014) Dotti and Spithoven (2017)
Generation of evidence and finding information	KBs solicit evidence and help in finding information through conducting high quality research, participatory collaboration throughout, interviews, meetings, field visits and reviews of literature	Irwin and Githinji (2016) Reyers et al. (2015) Sherrington (2000) Van Kammen et al. (2006) Hutchinson et al. (2011)
Synthesizing evidence and policy analysis	Help in synthesizing and package evidence in a timely manner	Reyers et al. (2015) Van Kammen et al. (2006)
Use of evidence	Help in applying research for agriculture, fostering demand articulation, capturing technology needs and accessing funds	Moumouni and Labarthe (2012) Klerkx and Leeuwis (2008)
Access to information	Also ensuring access to information for funding from local buzz	Dotti and Spithoven (2017)
2. Linking Connector		

Connecting all critical stakeholders to create networks	Help connecting all critical stakeholders, players and relevant actors in specific implementation contexts (for example disaster management), to form networks, communities of practice so as to understand complex problems, co-construct and coproduce evidence.	Irwin and Githinji (2016) Reyers (2015) Sherrington (2000) Sitas et al. (2016) Hare et al. (2014) Dotti and Spithoven (2017) Pelletier et al. (2018) Klerkx and Leeuwis (2008)
Connecting implementers to evidence/knowledge	KB also links implementers to evidence and knowledge networks	Reyers et al. (2015)
Connecting researchers to policy makers	Connects research institutions to Think tanks for collaborative research, and also links users of evidence to producers through formation of National platforms	Chikozho and Saruchera (2015) Hutchinson et al. (2011) Moumouni and Labarthe (2012)
Connecting researchers to funding	Links (risk and disaster) researchers to funding and to other organizations	Dotti and Spithoven (2017)
3. Capacity builder		
Capacity for knowledge brokering	Strengthened national and regional capacity for knowledge translation and dealing with information	Irwin and Githinji (2016) Van Kammen et al. (2006)
Capacity to understand policy	Enhanced understanding of MSN through informal conversations, small group meetings, workshops, and conferences	Pelletier et al. (2018)
Capacity for disaster risk reduction	Strengthened global and national capacity	Hare et al (2014)
Capacity to use resources	The researchers trained agriculturalists on agricultural technologies and they in turn trained them on agricultural needs	Moumouni and Labarthe (2012)
Building additional skills	Building additional skills and new budgets was an outcome	Reyers et al. (2015)
4. Facilitator		
Facilitating dialogues and engagements	Facilitated dialogues and engagements with stakeholders, and arranged conferences and events	Irwin and Githinji (2016) Sherrington (2000)

Facilitated collaborations and partnerships	Facilitated the creation of implementation teams, sectoral working groups, and formal alliances. collaboratively designed actions for disaster risk reduction for instance	Reyers et al. (2015) Pelletier et al. (2018) Klerkx and Leeuwis (2008)
Secure funding	They help secure funding for their stakeholders	Dotti and Spithoven (2017)
Facilitated learning	Enhance learnings and improve awareness on various issues	Pelletier et al. (2018) Klerkx and Leeuwis (2008)
Management of processes	Play a role in management of processes including alignment and mediation of the different stakeholders	Klerkx and Leeuwis (2008)
5. Evaluator		
Knowledge products	Quality of knowledge products developed and shared through different platform	Sitas et al. (2016) Chikozho and Saruchera (2015) Hare et al. (2014) Dotti and Spithoven (2017)
Engagements	Evaluating the quality of engagements between partners	Sitas et al. (2016) Chikozho and Saruchera (2015) Hare et al. (2014)
Learning	Evaluating lessons learned from KB activities	Sitas et al. (2016), Hare et al. (2014) Reyers (2015)
Outcomes	Evaluating the outcomes of knowledge brokering	Sitas et al. (2016), Hare et al. (2014) Reyers (2015)

Interaction across knowledge brokering roles

In general, all roles were inter-linked although not all private sector players undertook multiple roles. The synthesis revealed that the extent to which the private sector player undertook multiple roles was driven by their ultimate goal as well as the availability of resources. The private sector invested in generating better information by convening actors to generate this information and to support its utility (Hare et al., 2014; Sitas et al., 2016). Limited resources and time also meant that they sometimes could not build capacity or invest resources for additional knowledge brokering. Those who aimed at influencing decision making and practice tended to invest widely in information systems, professional expertise, interaction platforms and build partnerships (Chikozho and Saruchera, 2015; Dotti and Spithoven, 2017; Irwin and Githinji, 2016; Pelletier et al., 2018; Reyers et al., 2015). For example Pelletier et al. (2018) describes four case studies across Africa where a private

northern university funded knowledge brokering to influence multi-sectoral nutrition policies. In these cases, the private sector provided fora and learning platforms for discussion at regional levels, which were cascaded to district and sub-county levels in some countries. It also facilitated integration of nutrition indicators in district development plans, they also trained national actors in Mali on participatory evaluation, strategic planning and group facilitation. Dotti and Spithoven (2017) describe the efforts of think tanks based in the EU to influence policy by strategically locating themselves, spreading information about published calls, setting up transnational consortia of appropriate partners, supporting administration of projects, and disseminate results. These think tanks invested long term in systems to foster communication among peers, promote research and science dissemination, represent professional interests and provide policy advice. They achieved this by making use of their location within the EU to obtain information about upcoming funds and linking this information to appropriate stakeholders (Dotti and Spithoven, 2017). Hare et al. (2014), on the other hand, describe an initiative where the private sector partners with other sectors to reduced natural hazards. However, despite co-construction of core issues and co-production of actions to address them, the initiative was challenged by low investment, poor coordination and poor follow through.

Motivations for knowledge brokering

To the extent that it was mentioned, the drivers of private sector involvement ranged from more altruistic/selfless concerns for the welfare of others, to clear self-serving motives and a delicate balance of achieving both. For instance, the majority of studies indicated that the private sector's predominant motive was to ease decision making processes by providing well packaged information and bringing in stakeholders who were critical for making things happen. They aimed to provide robust evidence for informed policy making (Chikozho and Saruchera, 2015; Irwin and Githinji, 2016; Sherrington, 2000) and collaborative decision making towards better practices (Hare et al., 2014; Reyers et al., 2015; Sitas et al., 2016). Others primarily sought to reduce partner risks (Hare et al., 2014; Reyers et al., 2015; Sitas et al., 2016) although clearly by reducing these risks they also ultimately reduced their own risks. In South Africa, for example, insurers benefited from knowledge brokering by identifying and fostering mechanisms to reduce disaster related risks but also benefited their clients (Reyers et al., 2015; Sitas et al., 2016). Other studies indicate that some private sector actors are simply motivated by business survival (Dotti and Spithoven, 2017; Reyers et al., 2015). Figure 4 provides an overview of motivations.

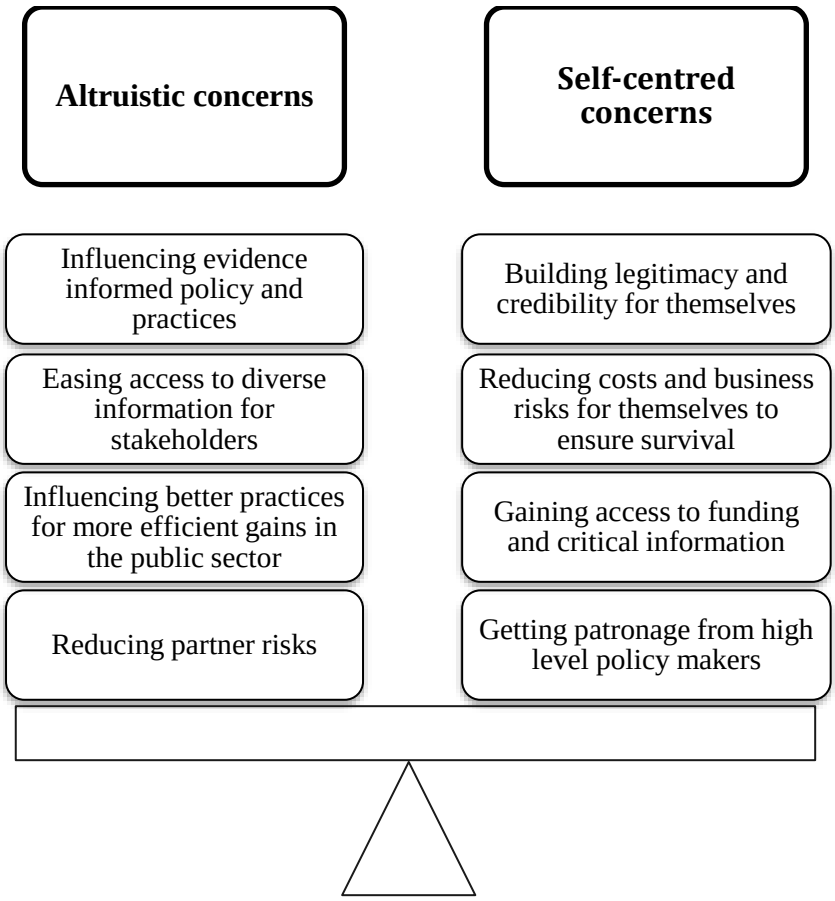

Figure 4: Motivations for knowledge brokering in the private sector

Structural challenges facing the private sector

The challenges which constrain private sector knowledge brokering tended to be either intrinsic or extrinsic. Extrinsic factors included context (both political and institutional), hidden interests, reversed policies, attrition of champions, limited funding, conflicting timelines, poor co-ordination, and lack of stakeholder capacity. Intrinsic factors included the lack of knowledge of stakeholder positions, lack of follow up, and lack of funding. The private sector actors' own conflicts of interest, overt or perceived by partners, frequently constrained their knowledge brokering efforts (Irwin and Githinji, 2016; Mbadlanyana et al., 2011; Sherrington, 2000; Sitas et al., 2016).

Country and institutional contexts also constrained knowledge brokering activities. For instance, political contexts presented a challenge because decisions tended to be driven by direct lobbying rather than evidence, and the private sector players did not always know which players had competing interests (Klerkx and Leeuwis, 2008; Irwin and Githinji, 2016). Institutional contexts also constrained knowledge brokering because progress was limited by the lack of institutional capacity, bureaucratic processes, lack of funding and poor infrastructure, such as limited communication systems (Chikozho and Saruchera, 2015;

Klerkx and Leeuwis, 2008; Moumouni and Labarthe, 2012; Pelletier et al., 2018; Sitas et al., 2016). Other constraints included unknown vested interests across stakeholders, conflicts of interest and, sometimes, overt competition (Chikozho and Saruchera, 2015).

Discussion

Diversity and versatility of private sector actors

The first challenge encountered in synthesizing the role of the private sector is the diversity in the private sector itself. The selected studies embodied the diversity within the private sector with players ranging from individual knowledge brokers to partnerships/associations and from small to large multinational enterprises. The studies encompassed professional and trade associations as well as universities across diverse contexts. This diversity of private sector players with limited information available within the papers to further characterize them, made it particularly challenging to synthesize our data. Di Bella et al. (2013) highlight the diversity and complexity of the private sector in terms of entities involved, scope of operations, geographical location, services provided and partnerships among other things, make characterizing the private sector a challenge. Moreover, the papers reviewed did not clearly state their corporate goals for us to assess their alignment with the SDGs.

The private sector's versatile role in knowledge brokering depicts its flexibility, willingness and ability to evolve in order to connect people, resources and ideas. In this sense, it is somewhat a chameleon, adapting to its environment. The private sector extends its knowledge brokering role beyond merely providing research evidence to providing added value to multiple stakeholders, wherever necessary and in the form needed by stakeholder. For instance, when the private sector connects experts to policy makers and to research groups, it has the potential to facilitate better research and better policies through the process of knowledge co-creation. By connecting researchers and implementers to funding sources, it is able to facilitate the conduct of research and the implementation of policies. The private sector's advantage here might be inherent in its access to funding and limited bureaucratic red tape when it comes to instituting changes (Chikozho and Saruchera, 2015).

The private sector does not undertake knowledge brokering in an ad hoc manner but rather invests strategically in infrastructure, systems and experts to enable it to succeed. For example, private sector actors in Brussels are strategically locating themselves geographically within policy making locales (Dotti and Spithoven, 2017). Further, the private sector is willing to invest in high quality professionals in order to build credibility and information management systems such as e-platforms in order ultimately becoming the 'go to' persons for all sorts of information for their diverse partners (Hutchinson et al., 2011; Irwin and Githinji, 2016; Reyers et al., 2015; Sherrington, 2000; Van Kammen et al., 2006). They invest in communication platforms and package their evidence for multiple groups and host platforms which enable stakeholders to hold engagements (Hare et al., 2014; Irwin and Githinji, 2016;

Reyers et al., 2015; Sherrington, 2000; Sitas et al., 2016; Van Kammen et al., 2006). Moreover private sector knowledge brokerages continuously evolves in primary in order to fit prevailing trends and those that fail to evolve may become obsolete (Sherrington, 2000).

Barriers: contexts, motives and resources

The successful engagement of the private sector actors was moderated by the context. Contexts that tended to be heavily political presented challenges because of the hidden interests of other players and these made the terrain difficult to navigate. In these instances, private sector actors found that evidence and processes did not matter. They learned that what ultimately mattered was credibility, trust, access to power and legitimacy. Some articles (Chikozho and Saruchera, 2015; Irwin and Githinji, 2016; Reyers et al., 2015) highlight the value of investing in expert personnel and communication systems to build credibility and trust and as well as having 'insider' knowledge. On occasion, the private sector's motives were questioned by their partners and this threatened their influence. This conflict of interest, whether real or perceived, tended to manifest early in the engagements but sometimes dispelled once trust was established.

The resources (human resources, funds, time) possessed by the private sector institution was a constraint in that minimal resources limited the capacity of the private sector to engage. This reduced their ability to pay fees of professionals, their capacity to build robust communication systems and the provision of platforms to facilitate policy dialogue. Moreover, the timelines of policy making tended to conflict with the timelines of the private sector and the private sector often did not have adequate time to achieve their outcome. For example, by the time the private sector established links, facilitated engagements and drew up implementation plans, the disaster risk management projects had run out of time and funding for implementation (Reyers et al., 2015; Sitas et al., 2016). External funding provided by development partners also proved to be a source of contention. The argument was that governments perceived externally funded knowledge brokers as conflicted and pursuing external agendas and therefore mistrusted them, although they did not have the funding to support the projects (Mbadlanyana et al., 2011).

Success: strategic alliances and outcomes

Creating competent, strategic alliances and positive relations with power facilitated the engagements in knowledge brokering. The private sector created competences by hiring professionals, seeking knowledge from credible sources, building strategic partnerships, facilitating productive dialogue and investing in communication systems, which adapt to the needs of their audiences. This proactive approach gave them prominence, credibility and relevance to their different stakeholders as competent and responsive agencies. For example, Irwin and Githinji (2016) highlighted the importance of staying ahead of policy processes in order to provide timely and relevant inputs by anticipating demand and actively filling the

gap, while Reyers et al. (2015) emphasized the value of filling the gap between policy and knowledge by actively playing the mediator role.

The outcomes of knowledge brokering activities ranged from policy and practice influence, generation of funding for implementation, building of capacity, to establishment of engagement platforms and learning networks. Reyers et al. (2015) for instance reports that the KB activities resulted in the establishment of learning networks across different groups which yielded multiple benefits such as improved response to disasters job creation program to achieve improved water yield, decreased pumping costs, new investments in eco systems services, shifts in policy and practice and new collaborations in eco system disaster risk reduction. In general the new partnerships led to pooled resources and resulted in shift from short term to longer term disaster management (Reyers et al., 2015). Sitas et al. (2016) report on the establishment of communities of practice with increased knowledge production but limited time resources and institutional capacities to achieve intended goals. In Kenya, multiple case studies reported influencing shifts in policy and practice although some policy shifts were later overturned (Irwin and Githinji, 2016). This might imply that unless those most affected by the issues play a major role in assuring that the solutions are culturally and contextually appropriate, they are unlikely to succeed (Manzini, 2015). In order to successfully navigate the ever changing policy development terrain and to ensure that private sector knowledge brokers remain relevant, the private sector would need to employ human centred design approaches to knowledge brokering. This would entail identifying and engaging the intended users in the process of co-producing context appropriate knowledge products as well as evaluating these products against user needs (Manzini, 2015).

Reflections on the theoretical framework

This synthesis attempts to operationalize social capital and integrate it with the Glegg and Hoens (2016) meta-framework. It established that social capital was a valuable addition because it became easier to explicitly focus on and distinguish between the relational, structural and cognitive components of knowledge brokering. Glegg and Hoens (2016) meta-framework, and many of the models and frameworks on which is it based, tend to emphasize the relational components of knowledge brokering at the expense of the structural and cognitive components. This is not to say that the relational aspects and the categories of roles are not important – indeed, in working with different types of actors, intrinsic to brokering, they may be predominant – but that the overt focus on relational aspects might obscure the importance of institutional structures in hindering or supporting knowledge brokering. In addition, the advocacy/lobbying role has been added to the Glegg and Hoens (2016) meta-framework, enriching the different roles.

This study found evidence of the importance of personal relationships and trust as a basis for knowledge brokering, closely related to the relational component of social capital. For example, Chikozho and Saruchera (2015: 285) consider that 'the existence of personal

relationships between individuals in these institutions usually acts as the main catalyst for long lasting collaboration on research and policy engagement' while Hare et al. (2014: 2161) establish that 'there can be no substitute for creating opportunities for allowing network members to meet in person, for instance, through workshops. Such meetings create trust and bonds, and support the sharing of knowledge'. Future research should incorporate closer reference to these additional elements of advocacy/lobbying and of relational, cognitive and structural social capital. This has led us to develop a new theoretical framework, specifically focused on knowledge brokering with the private sector.

Limitations of the study

The study establishes that there is a very limited published literature focusing on the knowledge brokering role of the private sector. Many studies mention working with the private sector; which was why they were selected by the literature search in the first place – but that, in reality, this amounted to a sort of 'name dropping' but not actual engagement, possibly because of the current emphasis on the private sector within the discourse on international development which implies that referring to the private sector is socially desirable.

There are a number of possible explanations for this paucity of published literature. First, we suspect that the bulk of literature on the private sector's knowledge brokering activities might exist in unpublished grey literature but this literature was not visible in the references we studied, indicating that there is no real body of interconnected knowledge in this field. Second, as we observed earlier in this article, we consider that the private sector is not writing up its experience of knowledge brokering because scientific publication is very low on its list of priorities. Third, another possibility, and we think this is most likely, is that working with the private sector in knowledge brokering is happening at program level and therefore under the scientific radar it is likely that examples are very dispersed and fragmented. For this reason, our next step will be to examine the current practice of working with the private sector by empirical research of multi stakeholder partnerships which are focused on knowledge brokering as we briefly discussed above. Other papers have also proposed that consulting experts to examine practices is a valid scientific approach when no literature is available on a certain subject (Cummings et al., 2019).

Given that the synthesis is only based on 13 studies, is it scientifically valid? Two mutually reinforcing perspectives support the scientific validity of the current study. First, the methodology has facilitated in depth analysis of the literature, providing a nuanced perspective on the role of the private sector and, thus, has an intrinsic scientific validity. Second, the analysis not only resonates with the meta-framework of knowledge brokering but has added to this theory in a way which will be useful for other researchers, and which adds more depth to the concept of knowledge brokering.

Conclusions

The private sector is playing an increasingly prominent role in service delivery and policy influencing. Despite this, the understanding of the role of the private sector in knowledge brokering within international development is very fragmented. This synthesis therefore represents a useful approach to better understand the role of the private sector in international development. It has developed and tested a theoretical framework for developing insights into the private sector in knowledge brokering which will be further tested in empirical research.

One of the problems with analysing the role of the private sector in international development more generally, rather than only knowledge brokering, is the use of the term private sector which covers such a diversity of institutions with very different objectives. For this reason, we suggest that additional research should take a more nuanced approach to examine how the discourse of the private sector is being employed in the international development sector, and implications of this for working with the private sector in multi stakeholder partnerships.

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Multi-stakeholder dialogue space on farmer-led irrigation development in Ghana: an instrument driving systemic change with private sector initiatives

Thai Thi Minh, Olufunke Cofie, Nicole Lefore and Petra Schmitter

Private sector actors bring expertise, resources, and new perspectives to agricultural development, but the tendency to short-term approaches and market-based orientation has been unable to drive a systemic change in the development agenda. We explore how multi-stakeholder dialogues can capitalize on and trickle systemic change through private sector involvement. Analysis from the farmer-led irrigation development multi-stakeholder dialogue space (FLI-MDS) in Ghana shows the need for a physical and institutional space to cater for and merge different stakeholder interests. For all stakeholders, the institutional space is a multi-level-playing institution which can trickle systemic change by leveraging the private sector's investments with multi-stakeholders' collaboration, interactive learning, and potential support for commercial scaling of FLI. For private sector actors, a physical space for collaboration is crucial. It enables them to envisage their commercial interests, opening up opportunities for collaboration and mobilization of resources. Ensuring long term sustainability of an FLI-MDS requires catering for the private sector needs for a physical dialogue space to trickle systemic change and accelerate commercialization in farmer-led irrigation development.

Keywords: private sector; farmer-led irrigation; agricultural development; multi-stakeholder dialogues; systemic change; Ghana

Introduction

Development partners and organizations, regional bodies and governments have increased recognition of the need for private sector investment toward achieving economic growth, environmental sustainability and poverty reduction in Sub Saharan Africa (SSA) (Naseem, Spielman & Omamo 2010; German, Cavane, Sitoe & Braga 2016; Husmann & Kubik 2019). This reflects, in part, a response to the decline of public investments in much-needed, high-quality and evidence-based research to drive agricultural development outputs across SSA (Naseem, Spielman & Omamo 2010). At the same time, it reflects the rapid growth of private sector roles in agricultural production, value chain development, and research and innovation (Naseem, Spielman & Omamo 2010; Husmann & Kubik 2019).

Private sector, understood here as enterprises, companies or businesses, social enterprises, regardless of size, ownership and structure, has promoted new technology generation in plant biology, pesticides, fertilizers, machinery and irrigation. Often done in partnership with public investment, these new technologies have provided agricultural innovations that in turn increase productivity (Naseem, Spielman & Omamo 2010; Ragasa, Lambrecht & Kufoalor 2018). The private sector has also championed the commercialization of innovations in information, communications, business models, and micro-credit services that exhibit potential to address societal problems that constrain inclusive development (Baumüller, Husmann & Von Braun 2014). Moreover, public-private partnership (PPP) arrangements have been established in sectors where they strengthen complementarity of assets and overlapping interests between partners (Hall 2006). Whether through independent initiatives or through PPPs, the private sector invests resources and skills, and shares risk in business, research, extension, market and infrastructure development (Hall 2006; Ponnusamy 2013).

Private sector companies bring expertise, resources and new perspectives to agricultural innovation and development, but it would be unrealistic to expect that the private sector could do this widely and without other actors (Husmann & Kubik 2019). Private and publicly-supported innovations have been limited to scattered and localized pilots. Moreover, the common short-term, market-based orientation of many companies has been unable to drive a systemic change on the long-term development agenda. Solutions to global challenges require not only technological innovation, but linking technologies to broader national agriculture and innovation systems. Achieving systemic change, therefore, requires modalities that leverage innovations and also facilitate collaboration. One potential mechanism to facilitate collaboration between private sector companies and other actors across sectors is the creation of organizational and institutional spaces. Similar to other multi-stakeholder platforms and processes (Davies et al. 2018; Schut et al. 2019), these spaces bring together multi-stakeholders and provide them with a space for learning, action and change whilst stimulating private sector investments and partnerships.

Given this context, our research aims to understand how multi-stakeholder dialogues can capitalize on, and trickle systemic change through private sector investments[i]. We use the case of the farmer-led irrigation development multi-stakeholder dialogue space (FLI-MDS) in Ghana. Farmer-led irrigation (FLI) is characterized by farmers' own investments and direct engagement with the market, which is considered a promising potential alternative to irrigation development approaches characterized by large public expenditure in high cost infrastructure and public sector management (de Fraiture & Giordano 2014). The shift from public to private investment, as well as the need for innovation to address inherent opportunities and risks, make this a suitable case study. In the next section, we lay out the methodological approach used in this study.

Action research facilitating the FLI-MDS formation in Ghana

Development and facilitation of a FLI-MDS towards systemic change requires an approach that is responsive to systemic barriers and engages relevant actors and stakeholders[ii] across sectors in the co-creation of the intended change. This implies the need for a trans-disciplinary research and facilitation team to kick start relevant research, development, and multi-stakeholder dialogue processes. An action-based research process (Elden & Chisholm 1993; Dickens & Watkins 1999) was used to co-create a FLI-MDS in Ghana. Figure 1 illustrates the steps embedded in an action-reflection modality: analyze, conceptualize, co-develop, and reflect.

The *analyze* step responds to the questions: What is the state-of-art of FLI development in Ghana? What are current relevant investments and initiatives from Ghana's private sector supporting FLI? What are the private sector-led innovations that directly target FLI development in Ghana? We implemented a qualitative study that combined a literature review with semi-structured interviews. The literature review analyzed systemic barriers and opportunities to FLI development in Ghana. Semi-structured interviews were conducted with 12 companies in Accra, Ghana's capital and main commercial city. Targeted companies were those involved in the importation, manufacturing and distribution of irrigation equipment and services to farmers. To map the irrigation supply chain and characterize private sector investment in FLI, the following data was collected: 1) general company information, 2) business and activities, 3) cooperation with other private and public actors, and 4) constraints, challenges and strategy for business development in FLI. In the *conceptualize* stage, we reviewed literature about multi-stakeholder platforms and processes as well as different cases of multi-stakeholder initiatives in Ghana to theorize the FLI-MDS.

A multi-stakeholder workshop was organized to kick-start the *stages of co-develop and reflect*. In particular, the FLI-MDS concept was introduced and experiences in multi-stakeholder processes, collaboration and innovation were shared amongst stakeholders. Knowledge, experiences and expertise in FLI development were exchanged across private, public and research sectors. Finally, stakeholders' interests and agreement to common goals and functioning of the FLI-MDS were established. Participatory approaches were used to encourage active engagement of stakeholders. For example, the breakout group discussions reflected and captured the existing culture of collaboration and innovation scaling among stakeholders, and visualized the potential and role of FLI-MDS. Stakeholders were asked to: 1) identify common interests and goals, 2) define the mode of operation, and 3) envision the success and failure of a dialogue space.

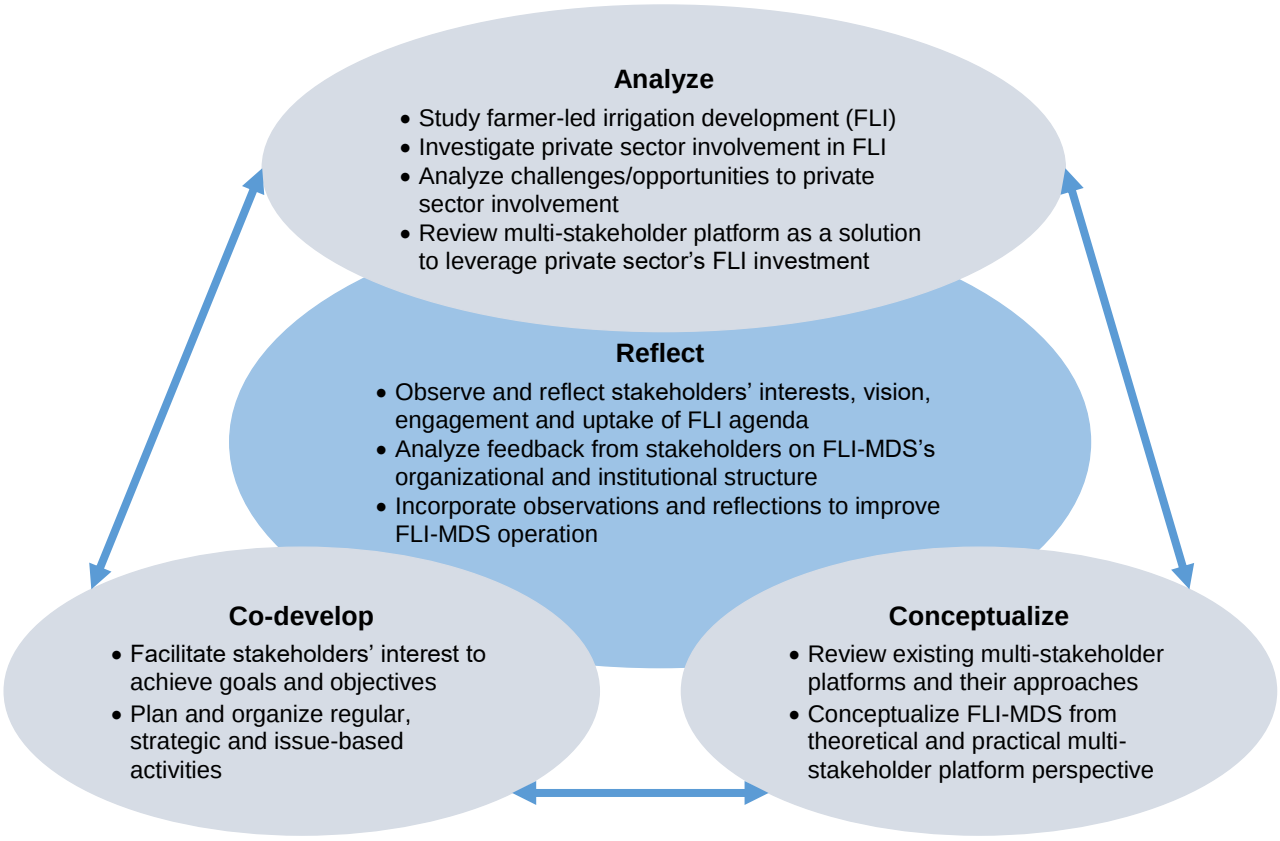

Figure 1. Process of developing FLI-MDS in Ghana

Farmer-led irrigation development in Ghana: potential and challenges

FLI development is defined as '*…a process in which farmers, individual and/or group, drive the establishment, improvement, and expansion of irrigated agriculture, often in interaction with other actors*' (Veldwisch, Venot & Komakech 2019:2). In Ghana, farmer-led irrigation is often referred to as micro- or small-scale or sometimes informal, in contrast to communal schemes or publicly-funded irrigation infrastructure systems that target smallholder farmers (Woodhouse et al. 2017). FLI development is a process, characterized by smallholder farmers making decisions on how they organize irrigation, where to farm, what to produce, and managing their own sales (Mdee & Harrison 2019). Studies in Ghana show that FLI accounts for over 189,000 ha, and employs 45 times more people, covering 20 times more land area than large-scale public irrigation schemes and benefiting about 500,000 smallholder farmers (de Fraiture & Giordano 2014; Namara et al. 2014). FLI is expanding at a faster rate than large-scale public irrigation systems, in part because farmers are able to make their own investments in water lifting, conveyance and application.

Despite the potential, FLI is so far limited to less than 2% percent of Ghana's cultivated land (Mendes et al. 2014) due to diverse challenges at multiple levels. At the *system level*, Ghana's Irrigation Policy, Strategies, and Regulatory Measures (GIP-2010) indicates four constraints to successful and sustainable irrigation: 1) low agricultural productivity and slow rates of return, 2) unclear socio-economic engagement with land and water resources, 3) environmental degradation associated with irrigated production, and 4) lack of irrigation support services. The overall national framework for irrigation and the institutional capacity of irrigation authorities and supporting actors do not support or enhance opportunities for FLI development. For example, public sector interventions give less attention to inclusivity in all stages of design, dissemination, adoption, and use of technologies that might be appropriate in the FLI development process (Lefore et al. 2019). Appropriate approaches to ensure equitable access to land, credit and extension services for smallholder farmers, women, and other marginalized population are missing due to the limited understanding on what and how irrigation technologies are used by these groups and in different contexts (Namara et al 2014; Mensah & Ibrahim 2017; Ragasa, Lambrecht & Kufoalor 2018). The promotion of private sector investment in irrigation has prioritized land allocation to large scale farmers and public-private partnerships arrangements to manage large-scale irrigation schemes.

At the *value chain level*, under-developed irrigation supply chains constrain farmer access to appropriate technologies[iii], services and information. Various factors that currently stifle supply chain development, include a complex set of financial regulations and tax regimes, complicated bureaucracies for importation, manufacture, and distribution of equipment and poor market infrastructure. Moreover, irrigation equipment importers, manufacturers, and distributors are confronted with uneven application of existing regulations and standards, as well as a limited access to credit for developing markets. The suppliers perceive a low demand for irrigation equipment and therefore are not motivated to expand into high risk, frontier markets. Furthermore, value chain development is biased to rainfed staple crops (e.g. maize, rice, cassava) and foreign exchange earning cash crops (e.g. cacao, cashew). Weak links between actors in the irrigated value chains result in high transaction costs to access markets, particularly in the context of limited infrastructure. The gaps between actors may also contribute to perceptions about low effective demand. Lastly, business and financial constraints for entrepreneurs, in combination with the poor coordination in value chains, further impede agriculture sector development. The missing or weak linkages between irrigation equipment suppliers and credit institutions, as well as between irrigators and produce buyers, discourage the development of a robust market for equipment supply.

At the *household level*, farmer investments in irrigation remain low, despite farmer willingness to invest, evidence of profitability, and potential to decrease manual irrigation labor (Balana et al. 2020). One of the major challenges is the high upfront investment cost for irrigation equipment such as pumps, sprinklers, and kits as well as the high energy cost (Namara et al. 2014; de Fraiture & Giordano 2014; Balana et al. 2020). Other challenges include the lack of physical access to

technologies due to market distance, after-sales services, appropriate agricultural inputs, financial services, extension services for irrigated production, and linkages to profitable output markets (Dittoh et al. 2013; Namara et al. 2014; Mensah & Ibrahim 2017; Balana et al. 2020). In sum, the constraints at the household level reflect the limitations and gaps at the value chain level.

Private sector investments in FLI

Analysing private sector investments from a supply chain perspective reveals three categories of investments: importation, manufacturing, and retailing. Figure 2 illustrates the structure of the Ghanaian irrigation equipment and service supply chain (GIES supply chain). Under *importation*, almost all equipment and products used for conveyance and application of water in Ghana are imported by general importers and wholesalers, as well as distribution agents, as indicated in Figure 2. The value of imports has increased significantly, from USD 17 million in 2010 to USD 81 million in 2012 (Mendes et al. 2014). Semi-structured interviews with some major importers (e.g. Dizengoff, SunIn, and Hatoum) show that their imported irrigation products are part of a wider product portfolio catering for different market segments, including water technologies for mining or domestic use. The market for irrigation systems specifically, is geared towards a limited number of large-scale commercial farms. Targeting smallholder farmer market segments requires specific attention to both the equipment and the business viability; these would not be economically feasible for the private sector.

With *manufacturing*, local companies have invested in the production of storage and conveyance equipment (e.g. multi-purpose water storage tanks, and PVC pipes) and recently added drip and sprinkler kits to their production portfolio. Semi-structured interviews with local manufacturing companies and importers show that the manufacturing investment segment is a niche area, as local manufacturers take advantage of the Government of Ghana policies and programs for Free-Zone enterprises. These policies provide grant waivers as incentives for investment in industrial production, export and employment generation. Such investment is very limited due to the strong competition from the imported products as expressed by a company representative:

> *'Why they [irrigation equipment suppliers] should invest in the local manufacture when price of almost locally manufactured products is generally higher than that of the same type of imported products. We are one of few companies investing in local manufacturing because we have the long-term strategy to develop product for West African irrigation market. Few others are investing in the local production to get benefits from the government's programs'.*

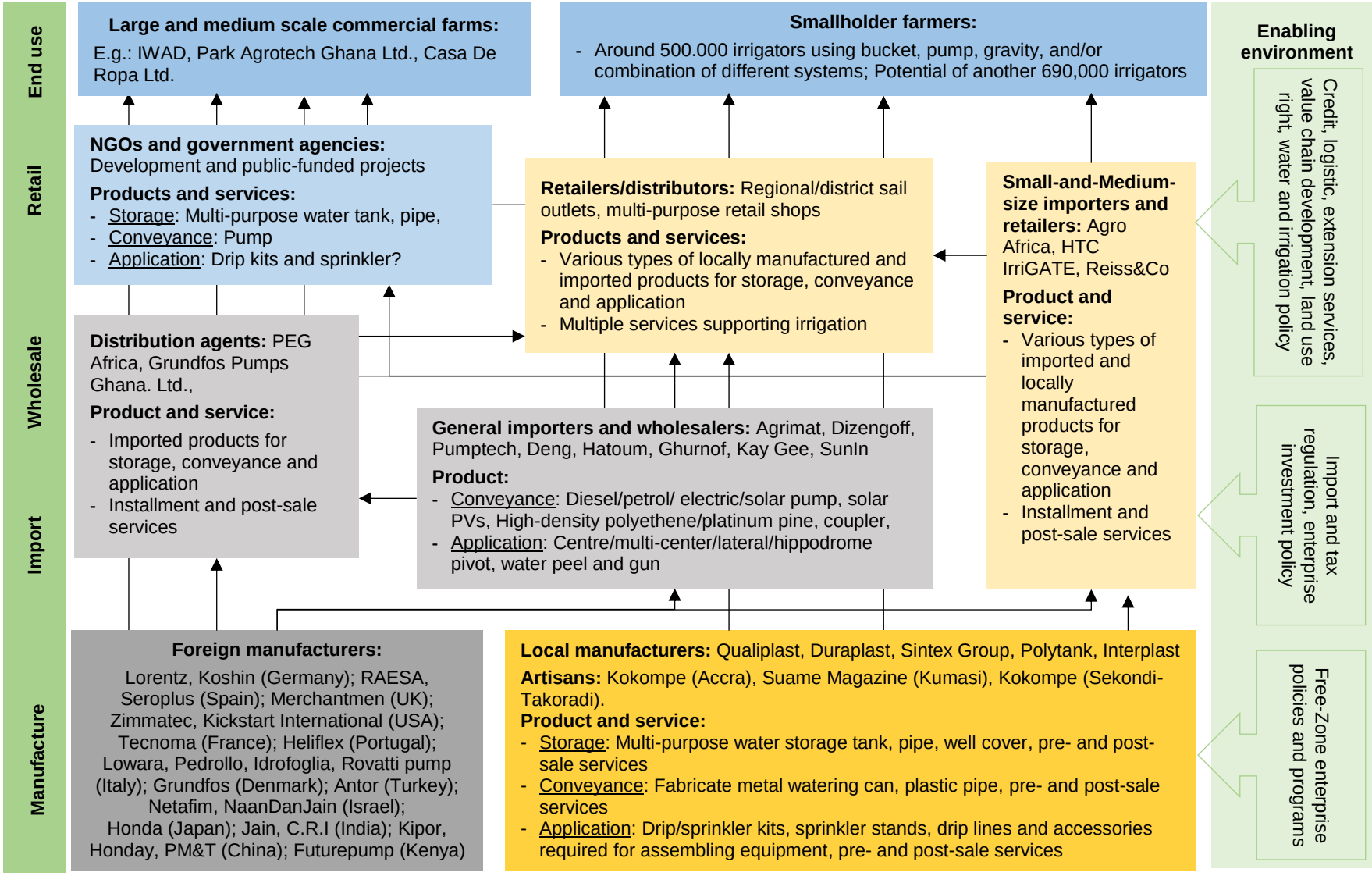

Figure 2. Irrigation equipment and services supply chain (Source: Authors)

A few artisans located in Accra, Kumasi and Sekondi-Takoradi are also involved in producing metal watering cans, basic foundry pumps, sprinkler stands, drip lines and various accessories. These small investments directly target FLI development, because costs are significantly lower than their imported counterparts and can be produced to meet individual demand of farmers. However, the types of equipment and scale of production are limited, and insufficient to stimulate irrigation development to the actual potential.

For investment into *retailing*, almost all the GIES supply chain's operators directly and/or indirectly distribute imported and locally manufactured equipment. The major importers distribute the products through a limited number of sales outlets and agents in Accra and regional capital cities. Some of these companies partner with development and government agencies to supply irrigation equipment to farmers through project-based operations as presented in Figure 2. At the district and community level, multi-purpose shops sell, in addition to agricultural inputs, irrigation equipment. These are mostly low capacity petrol, diesel, or manual pumps, and water storage tanks and PVC pipes, which are commonly used by households for storing and pumping water, as well as artisanal mining in some areas. Equipment installation and after-sales services are generally not included in sales. Rather, distributors may provide basic technical training on operation and maintenance of irrigation equipment to local service providers, such as mechanics, plumbers, and electrical technicians. Consequently, local technicians with insufficient training in the installation and repair of irrigation equipment are often the main technical and after-sale service providers to irrigators.

Although the estimated annual average of irrigation equipment sales was about USD 29 million around 2014 (Mendes et al. 2014), private sector investments mainly covered the supply of imported conveyance and application equipment. Aside from novel approaches noted by some of the interviewed SMEs, very few vendors offer customized packages of equipment and services. By focusing on the typical lifting-storage-conveyance-application chain, the weak linkages between credit and irrigation supply and between irrigators and producer markets continue to impede FLI development. Furthermore, government and development projects that offer incentives for private sector investment in agriculture and specific value chains tend to do so without integrating the irrigation equipment supply chain, thereby reinforcing the weak linkages throughout the system.

The interviews revealed that a growing number of small-and-medium size enterprises (SME) have recently invested in irrigation equipment retailing as demand by smallholder farmers increased. These SMEs import and distribute equipment to address smallholder irrigation needs, as expressed by a CEO of one SME:

> *We had come up with a new strategy since December 2017 to deal with small scale farmers who have from 1 acre to 10 hectares maximum. We have provided installation and after-sale*

> *technical support, credit, and market linkages to farmers. This business has brought the best year for us in 2019'.*

These SMEs provide more demand-driven packages consisting of water storage, conveyance and application equipment, as well as services such as pre-purchase survey and system design, installation, technical support, maintenance, credit, and market linkages. The innovative financing modalities show the potential to reduce high upfront costs, directly targeting the smallholder market segment that characterizes FLI development.

The case of the demand-driven SME business mentioned above suggests that business initiatives can be built around the smallholder market segment underpinning FLI development, i.e. the 'irrigation package for one acre to ten hectares'. This business case provides a customized, bundled package of irrigation equipment and services, and credits to farmer groups to ensure 1) an efficient irrigation system, 2) a group guarantee that each farmer is able to pay back after the third harvest, and 3) farmers are capable of expanding their irrigated farming area within two to three irrigation seasons. These recent business initiatives could reduce the high upfront costs, and thereby increase technology access for smallholder farmers, but other challenges off-set the potential. To tackle the systemic barriers and promote the business models that target smallholder farmers, there is need to strengthen the enabling factors, as shown in the right side of Figure 2. Moreover, there is a need to generate and facilitate collaboration for innovation and interactive learning between the private sector, as market leaders, and the broader categories of actors and stakeholders. Addressing these needs can, in turn, help to identify pathways to scale, and reduce constraints for scaling, thereby generating irrigation supply and demand enablers.

Considering the foregoing, a functioning interactive multi-stakeholder platform can simultaneously support innovation, provide appropriate inputs into stakeholders' plans, and inform relevant government policies and programs. In the following section, we conceptualize the farmer-led irrigation development multi-stakeholder dialogue space (FLI-MDS) as an interactive multi-stakeholder initiative to link the private sector's FLI development, end-user-focused investments with broader development actors and stakeholders in the agricultural water management sector.

Conceptualizing the FLI-MDS

Learning from multi-stakeholder platforms and initiatives

Multi-stakeholder platforms and processes have been effectively used by governments, research, and development actors for achieving development outcomes in agricultural research for development projects and programs (Davies et al. 2018; Schut et al. 2019). Although the functions and forms of these platforms and processes vary widely, a number of common features can be

identified across such initiatives. For instance, stakeholders' interests are very diverse and stakes high, sometimes challenging the management and participation of less 'powerful' stakeholders (Cadilhon 2013). Achievement of tangible benefits from the multi-stakeholder processes, therefore depends on institutional and individual commitment of the diverse stakeholders (Schut et al. 2019). Stakeholders need to gather around tangible issues with the potential for specific knowledge benefits, engaging in a virtual learning cycle, and visualizing tangible and short- to medium-term benefits (Davies et al. 2018). These conditions allow stakeholders to jointly work on and derive benefits that sustain their commitment and ultimate rewards (Swaans et al 2013). Engagement, customized training activities and knowledge sharing are needed to strengthen capacity, trust and ownership of multi-stakeholder processes (Lefore 2015).

In Ghana, various multi-stakeholder processes, such as innovation platforms, multi-stakeholder dialogues, or learning alliances, existed or still exist, addressing different issues of sustainable water use. For instance, the *Multi-Stakeholder Process for Policy Formulation and Action Planning (MPAP)* was used to facilitate strategic partnerships, and (AWGUPA[iv]) for an improved research-policy dialogue. These efforts resulted in the official recognition of the role and benefits of irrigated urban and peri-urban agriculture in Ghana (Drechsel et al. 2008). The platform aims to expand access to irrigation water for urban agriculture, to develop a sustainable urban farming system, and to contribute to urban poverty alleviation while enhancing urban food security and empowering the socially excluded. The *Ghana Dams Dialogue* brought together key stakeholders to share information, increase awareness about resettlement and dam related issues that affect local communities and provide guidelines and recommendation towards a policy framework, thereby contributing towards well-informed decision-making and sustainable planning and management of dams in Ghana. The innovation platforms, established by the *West African Agricultural Productivity Programme* (WAAPP) in collaboration with the International Centre for development oriented Research in Agriculture (ICRA), facilitate discussions around a particular commodity or cropping system with interest groups to disseminate technologies for widespread adoption.

Multiple lessons have been documented on leading and facilitating these and similar multi-stakeholder engagement processes. The multi-stakeholder processes are dynamic and tend to grow with time. Multi-stakeholder processes and dialogues that are established based on specific projects usually end at the close of the project (Amerasinghe et al. 2013). Their functionality is sustained when embedded in an established institutional and organizational arrangement and by considering a wider spectrum of agricultural water management issues rather than specific (and limited) project issues. Co-hosting of the platform by a group of core members with diverse organizational representation is key to creating shared ownership, maintaining institutional memory, and diversifying funding sources. Moreover, seed funding to address emerging issues as well as regular funding of the main activities, and joint sharing of costs are critical to strengthening multi-stakeholder processes' scope, management capacity, effectiveness, and sustainability.

Conceptualizing farmer-led irrigation multi-stakeholder dialogue space

FLI-MDS is needed in Ghana's irrigation sector for several reasons. *First*, whereas there is high potential for FLI development to change the agricultural landscape in Ghana, the associated challenges are too numerous to be achieved by individual actors. Individually, actors lack adequate resources and expertise to make the types of systemic changes required. *Second*, irrigation technologies are available, but adoption remains limited, partly due to low market integration, such as under-developed supply chains and output markets for irrigated products. *Third*, private sector companies often focus on profits with limited commitment or accountability towards smallholder farmers. Yet, government agencies, research organizations, and development actors are perceived to 'talk too much' with minimal relevant action on the ground. These mutual negative perceptions widen the gaps among irrigated agricultural value chain actors. Catalyzing collaboration can advance the development of the sub-sector. *Fourth*, actors within and across sectors must deal with systemic barriers and challenges in the irrigation sub-sector of a broader market system, about which there is little understanding. Each actor works toward narrow objectives with equally narrow approaches. This poor coordination hampers the identification of solutions or innovations. Synergistic opportunities exist amid the complementary needs and interests. Hence, the FLI-MDS aims to encourage collective thinking, collaboration, and action across multiple sectors and at multiple level to generate innovative ideas and solutions.

Based on the lessons learned from earlier multi-stakeholder platforms in country and available literature, we conceptualize FLI-MDS as a combination of a physical and institutional space where conversations among diverse stakeholders allow collective actions to evolve and deepen over time to actualize a shared vision on FLI development. The *physical space* is a place where the FLI-MDS stakeholders come together to meet naturally, communicate effectively, and interact comfortably to pursue shared objectives. A good physical space is a place that make the FLI-MDS stakeholders want to be there, to stay once they have arrived, and feel welcome, safe, and comfortable. The physical space becomes a common space when it is collectively owned by all stakeholders (Brouwer et al., 2013). Such spaces are therefore structured to enable communication and collaboration among stakeholders (Kilelu, Klerkx, Leeuwis & Hall, 2011; Kilelu, Klerkx & Leeuwis, 2013; Totin, Roncoli, Traoré, Somda & Zougmoré, 2018).

Yet, such physical spaces do not automatically generate sustainable, inclusive, and equitable multi-stakeholder dialogues and processes (Brouwer et al. 2013) unless institutional spaces are established. Institutional spaces aim to deeply engage the FLI-MDS stakeholders into cooperative learning and action towards advancing FLI development. Thus, *an institutional space* is a conducive institutional environment (Schut et al. 2019) constructed through FLI-MDS stakeholders' engagement, dialogues, and collective action and co-learning. To reach the constructed institutional space, the FLI-MDS stakeholders work together in identifying needs, negotiating priorities,

developing solutions, mobilizing, and exchanging resources, reaching institutional commitment, and building institutional capacity and memories. Through their interaction and engagement, stakeholders become aware of their different but also common interests, fundamental interdependencies and the need for collective action and collaboration to pursue shared objectives (Schut et al. 2019). Accordingly, the institutional space provides a neutral sphere to increase transparency and trust-based relations that enable the empowered and active participation of all (Brouwer et al., 2013).

The FLI-MDS gathers different groups of stakeholders along the irrigated agricultural value chains such as private sector (irrigation production manufacturers and services, wholesalers and distributors and other actors along the agricultural value chains), farmers-based organizations (women's groups, youth's unions, farmer organizations, farmer cooperatives), international and national NGOs, national and international universities and research organizations), development partners, and government agencies and departments with mandates for agriculture and irrigation development. Figure 3 visualizes the FLI-MDS's stakeholders and core objectives developed by the participants in the initial multi-stakeholder workshop. The conceptualized FLI-MDS aims to:

- *Facilitate the scaling of FLI development* by identifying and testing sustainable scaling pathways in the partnering with private sector and engaging with relevant stakeholders
- *Raise awareness and interest in the scaling* of *FLI development* by providing and sharing scaling knowledge and experiences, and discussing potential positive and negative impacts.
- *Foster interactive learning to enhance inclusive scaling of FLI development* by inspiring specific entities to be inclusive in approaches to enhance benefits for participation of women, youth, and geographically marginalized through specific entry points within irrigation value.
- *Support irrigation policy and planning processes* through sharing experience and insights which includes evidence to improve planning of water and other natural resources, and to open dialogues on policy agenda and instruments
- *Capitalize FLI 'good practices' for resource mobilization* by integrating the actors and their practices into scaling proposals and promoting FLI development to relevant stakeholders
- *Drive innovation for inclusive scaling of FLI development* by employing 'do-reflect-adapt-do' loops to develop scaling ideas to feasible solutions.
- *Enhance FLI-related institutional capacity and memories* through stored FLI development knowledge within the organizations and transmission between organizational members, to strengthen the sustainability of the FLI scaling contributing towards sustainable agricultural water management.

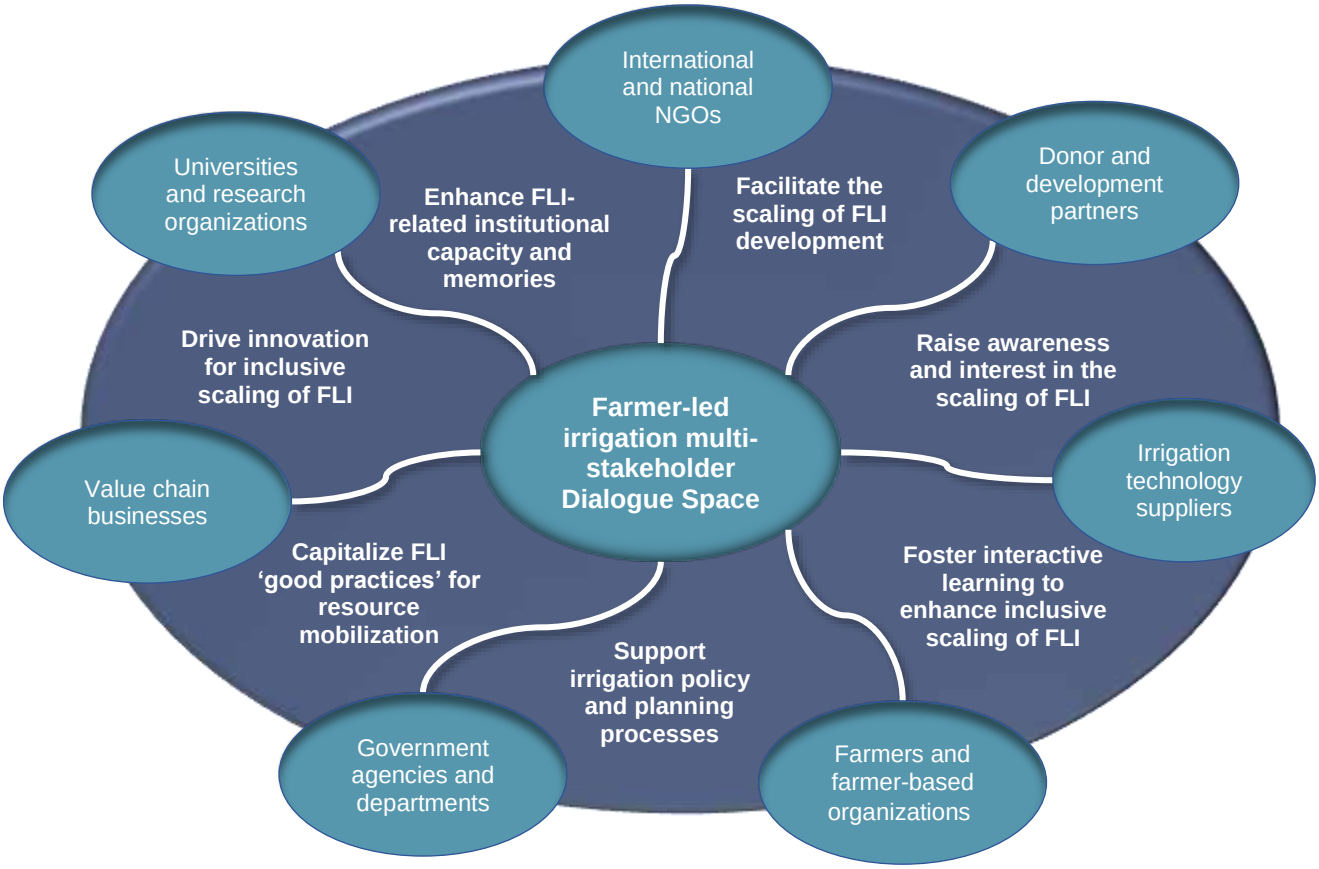

Figure 3. Conceptualized FLI-MDS Framework

Co-developing the FLI-MDS

The FLI-MDS is based on common interests and shared vision on enhancing inclusive and sustainable scaling of FLI development. This informs who chooses to be a member, the extent to which someone participates, and the activities undertaken within the platform. Intersecting interests allow collective actions to evolve and deepen over time toward achieving milestones toward the shared vision. Despite the diverse stakeholder mandates, the FLI-MDS participants identified a set of common interests:

- Increasing the adoption of FLI innovations and wider societal impacts on food security, livelihood, poverty, and gender inclusion by increasing market access, income and profits for FLI irrigators;
- Enhancing enabling environment by facilitating policy processes and infrastructure development towards sustainable water management;
- Enhancing agricultural water management capacity through learning opportunities, knowledge sharing, and skill development;
- Increasing access to FLI innovation and funding; and

- Fostering networking and business opportunities towards win-win collaboration by creating synergy, leveraging on the strengths and complementary and collective efforts. A successful FLI-MDS should be measured with Integrity, Governance, Action, Engagement, Collaboration, Learning, Growth, and Tangible impacts as presented in Box 1. Governing the FLI-MDS would entail six pillars covering the arrangement, structure, and processes: a physical space, institutional arrangement, distributed leadership, coordination and facilitation, community of interests, and planning and implementation.

Box 1. Successful indicators for the FLI-MDS

Integrity: Shared vision by and sustained interests of all stakeholders as well as complementary efforts and collective supports towards FLI development

Governance: Reliable and effective governance in place for running the FLI-MDS, building trust and commitment, and managing conflict of interests amongst stakeholders

Action: Having diverse and serious actions, including regular, strategic and issue-based activities in order to achieve the set of objectives

Engagement: Active participation and commitment of individual and organizational participants to the FLI-MDS

Collaboration: Having bilateral and multi-lateral partnership and collaboration among members towards promoting FLI development as well as sustainable agricultural water management

Learning: Adaptive learning to be able to learn from mistakes, reflect upon the weaknesses, leverage on others' strengths, and avoid walking in silos

Growth: Increasing participation and membership, expanding the scope towards a wider spectrum of agricultural water management, and institutionalizing the FLI-MDS by stakeholders

Tangible impacts: Increasing FLI productivity and production efficiency, mobilizing private sector's investments, and influencing government policies towards supporting FLI development

The *physical space* where participants come together to engage in dialogue processes must be available. Depending on its evolvement, multiple physical spaces can be identified and provided to be aligned with its dynamic growth and members' interests. The *institutional arrangement* is established by forming a facilitation team consisting out of different actor representatives. The team members are voluntarily working to identify strategic directions and to organize the implementation of FLI-MDS activities. They also facilitate stakeholder's interaction and collaboration to enhance inclusive scaling pathways for FLI development. Throughout the co-development process, the institutional arrangement will evolve, involving more voluntary individual and organizational members with the relevant expertise and mandates in the facilitation team.

Distributed leadership needs to be developed as the culture and mechanism that guarantees the sustainability and integrity of the FLI-MDS. Such leadership is a process taking place among the members of the FLI-MDS through shared, collective, and extended leadership practices, which

build the FLI-MDS's capability for growth and improvement. The *community of common interests* is established to fulfil the stakeholders' dynamic interests, their engagement, and potential contributions to the FLI-MDS's institutional and structural growth. Working and task-force groups can be formed ad-hoc by gathering a community of members who share a common interest to stimulate joined actions.

The *coordination and facilitation* is another core function of the FLI-MDS. At the beginning, actors requested that IWMI, together with a team of interested individuals of actors, further co-develop the FLI-MDS. Depending on an increase of activities and on an emergence of need, a coordinating and facilitating unit might be established with clear guidelines for planning, implementing, monitoring, and evaluating the FLI-MDS's activities and success. An individual and/or a group of lead coordinating and hosting organizations can be formed along the co-developing process to enhance the FLI-MDS's institutionalization and sustainability. The linkage between the institutional arrangement and the coordinating and facilitating bureau needs to be regulated to ensure the integrity.

The *planning and implementation* are other core functions of the FLI-MDS and these need to be done collectively, pro-actively, and strategically. The strategic planning needs to be done at the very beginning and along the co-developing process to identify, reflect, and adjust the strategic directions of the FLI-MDS. The pro-active planning and implementation need to be done periodically to develop and carry out a road map and financing strategy. These functions can be carried out based on three clusters of activities: 1) regular activities (e.g. regular meeting, exchange, and updates, annual planning, periodic events, and communication activities), 2) strategic activities (e.g. strategic planning, situational analysis and reflection, capacity development, strategic investment, and strategic events), and 3) issue-based activities (developing ideas into innovation, scaling partnership, and policy influence mission).

Private sector interest and engagement in FLI-MDS

Initiatives with significant private sector investment are shifting public perception on private sector engagement and the potential role to accelerate growth and agricultural development in SSA (Husmann & Kubik 2019). Climate change, unemployment, social inequality, and weak food systems all pose challenges to food security. Hence, many governments and international development organizations are looking to the private sector for business-for-development innovations that combine social value creation and profit maximization (Baumüller, Husmann & Von Braun 2014; German et al. 2016; Husmann & Kubik 2019), following earlier advocates, such as Elkington's Triple Bottom Line (Elkington 1998). However, private sector companies have largely been excluded from existing platforms in the irrigation sector.

In the FLI-MDS, private sector engagement is crucial for the result of dialogues and collective actions to trickle systemic changes. Notably, co-learning and evaluating business and financial modalities through knowledge exchange in FLI-MDS can create win-wins for the public and private sectors. The public sector can accelerate FLI development supporting agricultural economic growth, and food and nutrition security, whilst the private sector reaches more smallholder and resource poor farmers translating directly into business opportunities and economic profit. For example, the FLI-MDS provided a neutral physical and institutional space for private companies to outline the barriers associated with high taxes and transaction costs associated with (e.g. standard compliances and custom's authorities), supported by research-based evidence, to public agencies that participate in the dialogues. Easing policy barriers can in turn, enable the public sector institutions to achieve their larger development goals.

Furthermore, the FLI-MDS provides companies with opportunities for networking, identification of resources, and leveraging on available, limited opportunities. For example, the FLI-MDS created the space for networking between research and companies that led to a partnership between a research program[v] and PEG Africa in Ghana to test and refine new Pay-As-You-Go financing options for smallholder farmers, develop distribution systems for solar-based irrigation pump systems, and refine business models to reach those currently underserved by the market. In this case, donor funds are being used to de-risk private sector costs related to testing new finance modalities. In turn, the lessons from this partnership are being shared with other private sector partners that participate in the FLI-MDS. This elevates the experiences of a single private sector company to a public good, through discussion of the challenges encountered in designing appropriate business models and sharing of methods and tools innovated.

Another way to enhance private sector engagement is to bring relevant private sector companies together to bridge their fragmented efforts in targeting smallholder farmer market segments and create opportunities for collaboration and co-learning to support the scaling of FLI. For example, private companies exploring the irrigation equipment supply market in Ghana, have been able to access information about water resources from research institutions and projects. Private companies note that water resource mapping, and linking those maps to market studies, is costly; most private companies are not able to invest individually to develop such information. By sharing research-based information at the FLI-MDS that is of interest but beyond the scope of individual companies, companies are incentivized to continue to participate. This type of information sharing is also an incentive for research institutes to engage, as feedback from companies enables targeted research and contextually-relevant innovation. At the same time, the enhanced access to and use of evidence moves the agriculture sector toward meeting the national development challenges.

Private sector manufacturers and distributors of irrigation equipment are expanding rapidly into 'frontier' markets whilst developing and utilizing innovations to overcome challenges in financing and in agricultural extension. Participation of the broader private sector in the FLI-MDS is the 'lynch pin' to jointly and systemically bridge earlier identified gaps in FLI development. It is anticipated that better integration of private sector actors into this market sub-sector will result in: 1) accessible, appropriate irrigation technology supply chains, 2) reduced high upfront costs to irrigators through contextually suitable finance products and services, and 3) improved agricultural value chain and reliable, profitable market development to support irrigation investment. Furthermore, the FLI-MDS could, through interactive learning and win-win collaboration, tackle challenges around sustainable and inclusive scaling of FLI development.

Conclusions

Throughout the process of co-developing and facilitating the FLI-MDS, stakeholders see the FLI-MDS as a combination of a physical and institutional space where they come together. The physical space reflects the need to come together, enabling all actors and stakeholders to translate their objectives and stakes into a common vision through an exchange of ideas, interactive learning and joint exploration of opportunities to promote, invest and enable FLI scaling for smallholder farmers. The institutional space reflects the need to sustain the FLI-MDS through enduring stakeholders' co-learning, collective action, collaboration, and commitment towards the common vision. These spaces can be physically, virtually, and institutionally structured for communication and collaboration among stakeholders. These reflect the dynamic and flexible feature of the FLI-MDS to attract stakeholder engagement.

The FLI-MDS stakeholders fulfil different roles of the physical and institutional space. For private sector actors, the FLI-MDS is a space where business experiences are shared whilst providing a network to establish win-win collaborations between stakeholders that otherwise would not interact. This approach to the space reflects the private sector actors' commercial approach to pursuing opportunities for potential investments, collaboration, and resource mobilization, which are critical to ensure the private sector's continued engagement. For development partners, research organizations, and government, FLI-MDS is a space to accelerate scale and meet national targets on agricultural economic and sustainable development goals by sharing research-based knowledge and experiences. This includes discussing potential positive and negative impacts of scaling initiatives and progress, identify and test sustainable scaling pathways, capitalize on 'good practices' for resource mobilization, and develop feasible solutions to jointly identified challenges. So, matching short-term business expectations with advancing knowledge as a public good will be fundamental moving forward.

The FLI-MDS shifts a significant role onto the private sector, while also contributing to functions of government, irrigated agricultural value chain actors, and actors who seek to support smallholder farmers and marginalized populations. In this regard, it is also a multi-level platform with the potential to stimulate systemic change through different leverage points. These shifts in relationships, in turn, enhance private sector's engagement, trickling win-win collaborations towards systemic change. Crucial to the success of the FLI-MDS is ensuring long term capacity and memory among all stakeholders and actors to ensure continued business and development alignment going forward.

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[i] The initiative is supported through the Feed the Future Innovation Laboratory for Small scale Irrigation (ILSSI), which is funded by the United States Agency for International Development.
[ii] In this context, actors are those who are directly and continuously involved in the development and implementation of FLI development initiatives and responses. Stakeholders are those who influence or are influenced by, the FLI-MDS, but are not directly engaged in the development and implementation of FLI initiatives and responses.
[iii] Irrigation equipment includes manual and motorized water lifting, storage tanks, pipes and any other small scale equipment to store, lift and apply water.
[iv] AWGUPA: Accra Working Group on Urban and Peri-Urban Agriculture existed between 2005 and 2013
[v] Through ILSSI, the private sector investment catalyzes the expansion of irrigated, commercial production by smallholder farmers through a market systems development approach in Ghana and Ethiopia.

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L'implication du secteur privé international dans la gouvernance de la sécurité alimentaire en Afrique: diffusion d'un nouveau paradigme de développement agricole

The implication of the international private sector in the governance of food security in Africa: dissemination of a new agricultural development paradigm

Marie Hur and Liora Stührenberg

Depuis la crise alimentaire de 2007-2008, les acteurs privés internationaux (multinationales et fondations philanthropiques) sont considérés comme des partenaires clés dans la conception, le financement et la mise en œuvre des politiques agricoles et alimentaires, aussi bien par les dirigeants africains que par les donateurs. L'implication des acteurs privés internationaux a fait évoluer l'architecture de la gouvernance de la sécurité alimentaire et nutritionnelle, désormais marquée par la multiplication d'espaces hybrides dans lesquels les firmes internationales et les fondations philanthropiques jouent un rôle de premier plan. La très forte connexion des acteurs impliqués dans ces plateformes multiacteurs et la déclinaison de ces plateformes aux différentes échelles (internationale, régionale, nationale) assure la diffusion d'un consensus sur les modèles de développement. S'affirme ainsi un schéma de modernisation des agricultures africaines basé sur l'agriculture commerciale, et un modèle de "révolution verte" à forte mobilisation de capitaux et rentable financièrement. Bien que contestée par une multitude d'acteurs, cette vision peine à être mise en débat.

Since the food crisis of 2007-2008, international private actors (multinationals and philanthropic foundations) have been considered as key partners in the design, finance and implementation of agricultural and food policies, both by African leaders and by donors. The involvement of international private actors has changed the architecture of food and nutrition security governance, now marked by the proliferation of hybrid spaces in which international firms and philanthropic foundations play a leading role. The very strong connection of the actors involved in these multi-actor platforms and the variation of these platforms at different scales (international, regional, national) ensures the dissemination of a consensus on development models. There is thus affirmed a plan for the modernization of African agriculture based on commercial agriculture, and a model of Green Revolution with strong capital mobilization and financial profitability. Although contested by a multitude of actors, this vision is dominant in debate.

Introduction

Depuis une dizaine d'années, les acteurs privés internationaux (multinationales et fondations philanthropiques) sont de plus en plus considérés comme des partenaires clés pour financer et transformer les agricultures africaines, en vue d'assurer la sécurité alimentaire du continent. Dirigeants et donateurs ont ainsi développé un arsenal d'instruments pour faciliter l'implication du secteur privé dans le secteur agricole africain. L'architecture de la gouvernance de la sécurité alimentaire et nutritionnelle a, quant à elle, évolué pour se recomposer autour d'une multitude d'espaces hybrides dans lesquels les firmes internationales et les fondations philanthropiques – qui ont progressivement acquis une certaine légitimité à co-produire les politiques agricoles et alimentaires - jouent un rôle de premier plan. A cette évolution des processus politiques s'articulent des processus de production et de diffusion des savoirs.

Cet article s'intéresse à l'évolution corrélative, depuis le milieu des années 2000, des modalités de gouvernance et de la constitution des savoirs dans le domaine de la sécurité alimentaire en Afrique, marquées par l'implication croissante des acteurs privés internationaux. L'hypothèse que nous formulons est que l'évolution du discours et de la gouvernance en matière de développement agricole et de sécurité alimentaire sont deux processus qui se sont alimentés mutuellement et qui ont favorisé la diffusion d'un certain paradigme du développement agricole. Une vision techniciste et productiviste du développement agricole s'est largement imposée, alors même qu'elle est contestée par une multitude d'acteurs. Paradoxalement, le mantra de la gouvernance inclusive permet difficilement l'expression d'une pluralité de points de vue.

L'article est écrit sur la base d'une publication d'Inter-réseaux développement rural, du bureau Issala et de SOS Faim Belgique, *Le rôle croissant du secteur privé dans les politiques agricoles et alimentaires en Afrique* (Blein, Hur, Stührenberg, 2019) issue d'un processus de réflexion collective mené depuis 2017 au sein du réseau, et des résultats d'un atelier ayant réuni des représentants d'organisations paysannes, d'organisations non gouvernementales (ONG) et d'agences de coopération à Ouagadougou (Burkina Faso) en octobre 2019.

Comment le secteur privé est devenu un acteur central du discours sur le développement agricole et la sécurité alimentaire en Afrique

Une conjonction de processus contribue au milieu des années 2000 à faire du secteur privé un acteur clé du discours sur le développement agricole et la sécurité alimentaire et nutritionnelle en Afrique (SAN).

Après les indépendances, les États africains avaient globalement fait le choix de politiques

agricoles interventionnistes, fondées sur des investissements conséquents dans des filières jugées stratégiques. Les années 1980 marquent un tournant dans les politiques économiques en général et les politiques agricoles et alimentaires en particulier. Dans un contexte de crise des dettes publiques extérieures et de politiques de dérégulation de l'économie menées au Royaume-Uni et aux États-Unis, les institutions financières internationales conseillent aux pays pauvres endettés de réduire leurs dépenses, notamment en démantelant leurs politiques agricoles et alimentaires. La libéralisation de l'agriculture apparaît ainsi sur l'agenda des négociations de l'Accord général sur les tarifs douaniers et le commerce (GATT) en 1986. Ces politiques conduisent à la spécialisation agricole et à l'ouverture commerciale. Si des voix s'élèvent dès les années 1980 et tout au long des années 1990 et 2000 contre cette vision qui consiste à assurer la sécurité alimentaire par le recours au marché international, la crise alimentaire de 2008 achève de la remettre en question.

Certes, la crise de 2008 a été causée par une conjonction complexe de facteurs et n'est pas le signe d'une pénurie mondiale. Elle a toutefois donné globalement lieu à une forte volonté politique d'augmenter rapidement et conséquemment la production agricole, et particulièrement en Afrique (Bricas et Goïta, 2018; Blein *et al.*, 2019). Cette dynamique a été alimentée par les travaux de prospective et les nombreuses publications alarmant sur les risques accrus de pénurie alimentaire, avec une perspective constamment remise en avant : celle de devoir doubler la production agricole mondiale pour nourrir 9 milliards d'habitants d'ici 2050 (Fouilleux *et al.*, 2017).

Cette volonté s'est concrétisée en une multitude d'initiatives mettant l'accent sur la production : l'initiative *Feed the Future* de l'administration Obama (2010), la plateforme *Grow Africa* mise sur pied par le Forum économique mondial, la Commission de l'Union Africaine et le Nouveau Partenariat pour le développement de l'Afrique - NEPAD (2011), la NASAN initiée par le G8 (2012), ou encore le Défi *Zéro faim* lancé la même année par le secrétaire général de Nations-Unies Ban Ki-Moon.

Dans la mesure où elles reposent plus ou moins explicitement sur des modèles de production intensive (notamment en capitaux et en intrants chimiques), ces politiques visant un accroissement rapide de la production – et surtout de la productivité et des rendements – accordent une place de choix au secteur privé, et notamment aux grandes firmes internationales qui disposent des capitaux et des « paquets technologiques » présentés comme nécessaires pour augmenter rapidement les rendements. La feuille de route du Programme détaillé de développement de l'agriculture africaine (PDDAA) précise ainsi que « le secteur privé sera un partenaire clé pour la mise en œuvre, prenant parfois la direction des opérations. Si un effort spécial sera fait pour favoriser et soutenir le secteur privé national, l'ampleur de la tâche à accomplir commande que tous les niveaux du secteur privé – des entreprises locales naissantes aux multinationales créées de longue date – soient pro activement engagées en qualité de partenaires » (Union Africaine, 2015).

Le secteur privé contribue à l'élaboration d'un tel discours en mettant en avant ses atouts pour relever le « défi » des 9 milliards de bouches à nourrir, sur une planète de plus en plus peuplée et impactée par les effets des changements climatiques. Par exemple, les entreprises productrices d'engrais soulignent l'importance d'intensifier la production afin de limiter l'expansion des surfaces cultivées et les impacts sur la déforestation et les pertes de biodiversité. Sur son site internet, la firme Yara, leader mondial des engrais azotés, se donne pour mission de "nourrir le monde de manière responsable et protéger la planète" grâce à ses offres d'engrais et d'agriculture de précision qui "permettent aux agriculteurs d'accroître leurs rendements et d'améliorer la qualité de leurs produits, tout en réduisant les effets sur l'environnement" (Yara, 2020). Lorsque la nutrition a été intégrée à l'agenda de la communauté internationale à partir de l'organisation en 2014 de la seconde Conférence internationale sur la nutrition (ICN2), les acteurs privés ont également été actifs. Les industries agro-alimentaires jouent la fortification en ajoutant des éléments nutritifs dans leurs produits pour lutter contre certaines carences en micro-nutriments. Les industries semencières et les entreprises d'engrais chimiques ont également investi le créneau avec la bio-fortification. Les premières proposent des variétés, obtenues par croisement ou par modification génétique, plus riches en micro-nutriments. Les secondes proposent des engrais enrichis en zinc, bénéfiques à la fois pour la nutrition des plantes et des Hommes (Bricas et Goïta, 2018).

Parallèlement à ces évolutions, les réflexions sur le financement du développement contribuent aussi à donner une place de plus en plus importante au secteur privé. Au niveau mondial, les Objectifs de développement durable (ODD) adoptés en 2015 donnent lieu à des exercices d'estimations des besoins d'investissements qui montrent que les pays en développement afficheront un déficit de financement pouvant atteindre 2 500 milliards de dollars par an sur la période 2015-2030 pour atteindre les ODD (CNUCED, 2016). Or, l'aide internationale et les gouvernements africains avouent de leur côté peiner à mobiliser des financements supplémentaires et se tournent vers le secteur privé.

Ainsi, en 2014 à Malabo, les chefs d'États africains, reconnaissant leurs difficultés à respecter l'objectif qu'ils s'étaient fixé en 2003 de consacrer 10% de leur budget au secteur agricole, s'engagent à « créer un environnement politique et institutionnel, ainsi que des systèmes d'appui appropriés ou améliorer ceux qui existent, pour promouvoir l'investissement privé dans l'agriculture, l'agrobusiness et l'agro-industrie » (Union Africaine, 2014). Quelques mois plus tard, en juillet 2015, la troisième Conférence internationale sur le financement du développement considère à son tour que la mobilisation du secteur privé est nécessaire, plaidant alors pour un changement majeur dans la logique traditionnelle d'intervention de l'aide publique au développement : historiquement positionnée dans le financement des biens ou services publics, l'aide publique au développement devait désormais rechercher un effet « catalytique » ou « levier » sur les financements privés afin de mobiliser l'épargne et les actifs

financiers à l'échelle mondiale. Concrètement, la recherche de cet « effet de levier » conduit à mettre en place des instruments de financement du développement de plus en plus complexes et hybrides. Les ressources publiques sont placées dans des fonds de garantie ou des fonds d'investissements qui doivent permettre aux entreprises de lever des fonds complémentaires par emprunts auprès de banques commerciales. (Gabas *et al*., 2017). Il est toutefois difficile d'établir la participation accrue du secteur privé au financement du développement agricole : il existe souvent un décalage entre les effets d'annonce et leur mise en œuvre effective (Blein *et al.*, 2019).

D'une certaine manière, le discours sur la synergie public-privé participe à effacer les limites entre intérêts privés et biens communs et donc à légitimer l'implication croissante du secteur privé dans la production des politiques publiques. Cette évolution a été grandement facilitée par la réconciliation – du moins dans les discours – entre intérêts privés des firmes agro-industrielles et biens communs dans le domaine agricole et alimentaire.

Comment le secteur privé international a contribué à modifier la gouvernance de la sécurité alimentaire et nutritionnelle

A partir des années 2000, les firmes et fondations privées impulsent de nombreuses initiatives qui contribuent à modifier la gouvernance de la SAN.

Le secteur privé institutionnalise sa « nouvelle vision de l'agriculture »

En 2004, la firme Yara lance son Programme Afrique, en réponse à l'appel du Secrétaire général des Nations Unies, Koffi Annan, pour une révolution verte en Afrique. Sur le modèle asiatique, la révolution verte doit permettre de faire sortir le continent africain de l'insécurité alimentaire, en développant notamment l'irrigation, les cultures vivrières et l'utilisation d'intrants (voir page 115). Yara participe ensuite - avec Monsanto, Unilever et la fondation Rockefeller - à la *Task Force* sur la faim mise sur pied par le Secrétaire Général des Nations Unies dans le cadre des Objectifs du Millénaire. Cette consultation des multinationales signifie qu'elles participent à édicter les « bonnes recettes » du développement agricole (structuration des chaînes de valeur, corridors de croissance agricole, partenariats public-privé pour faciliter l'investissement, etc.).

C'est également Yara qui promeut le concept de « couloir de croissance agricole », lors du forum du secteur privé qui s'est tenu en marge de l'Assemblée générale des Nations Unies de 2008. Concrètement, il s'agit de construire des infrastructures visant à attirer l'investissement et à faciliter le développement de l'agriculture commerciale afin de booster le secteur agricole, en particulier à travers le désenclavement et la connexion des zones agricoles à fort potentiel avec les ports (Binet, 2014). Cette idée de couloirs agricoles est inscrite dans le cadre du projet "Une nouvelle vision de l'agriculture" lancé par plusieurs grandes

multinationales, telles que Yara, Bayer, Cargill, Monsanto, Nestlé, Syngenta ou encore Unilever, au sein du Forum économique mondial en 2009. En 2010, Yara est également reçue par l'Assemblée générale des Nations Unies lors de la revue des Objectifs du millénaire pour le développement (OMD) et fera devant les États membres la promotion de son concept de couloirs de croissance (Binet, 2014).

Suite à ces différentes initiatives, 36 pôles de croissance agricole et neuf couloirs de croissance ont été développés dans 23 pays d'Afrique (Delcourt, 2019). Les corridors sont mentionnés comme l'un des piliers du plan d'industrialisation du continent mis en œuvre par la Banque africaine de développement (BAD) et le NEPAD (Issala et Inter-réseaux, 2017).

Un autre concept clé inscrit dans le programme d'action de la Nouvelle vision pour l'agriculture, est celui des partenariats public-privé pour faciliter les investissements dans l'agriculture africaine, tels que Grow Africa. Créé en 2011 par le Forum économique mondial, la Commission de l'Union africaine et le Nouveau partenariat pour le développement de l'Afrique (NEPAD), Grow Africa est une plateforme régionale de partenariats, regroupant plus de 200 entreprises et les gouvernements de 12 pays. Elle vise à créer des partenariats entre gouvernements africains et secteur privé par des engagements d'investissement du secteur privé appuyant le Programme détaillé de développement de l'agriculture africaine (PDDAA) et les stratégies nationales pour la croissance agricole. Grow Africa a soutenu la mise en œuvre de plus de 1,5 milliard de dollars d'investissements et de plus de 10 milliards d'engagements d'investissements.

C'est encore Grow Africa qui a assuré, à la demande du Forum économique mondial et avec l'appui de Yara, la mise en place de la Nouvelle alliance pour la sécurité alimentaire et nutritionnelle (Nasan). Ce partenariat regroupe les membres du G8 (sauf la France qui en est sortie en février 2018 sous la pression de la société civile), les gouvernements de 10 pays africains (en majorité ouest-africains), des entreprises nationales et internationales, des organisations internationales et des organisations paysannes africaines. Co-présidée par l'Union africaine, le Forum économique mondial et les États-Unis, la Nasan vise à améliorer la sécurité alimentaire et la nutrition en Afrique subsaharienne en misant sur la mobilisation de capitaux privés pour développer le secteur agricole africain.

La multiplication des plateformes multi-acteurs favorise une approche techniciste de la sécurité alimentaire

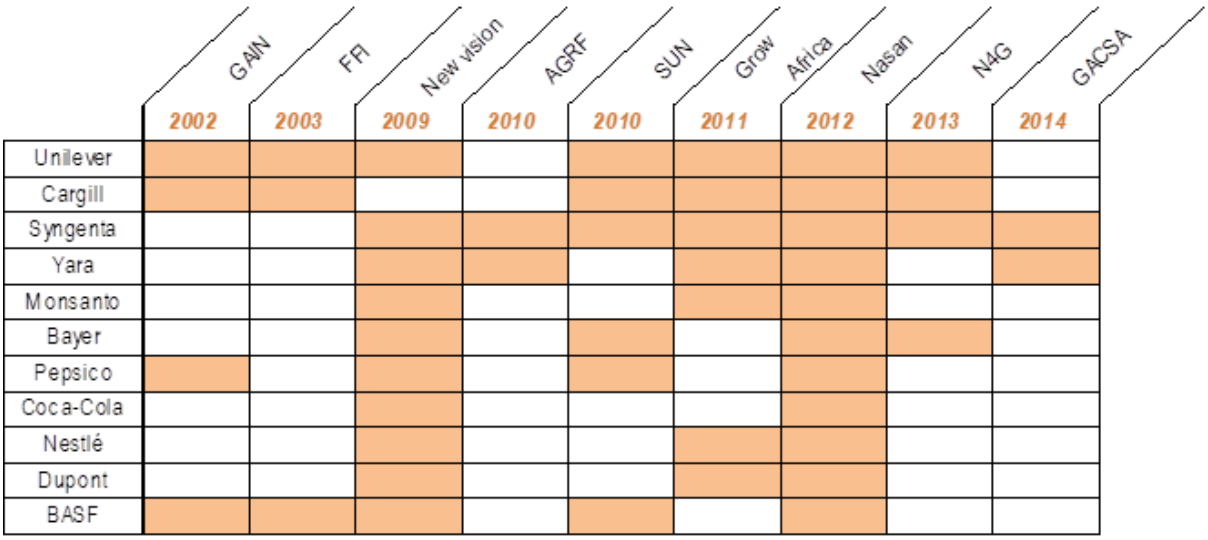
Les multiples alliances et initiatives consacrées à la SAN et au développement agricole en Afrique qui ont émergé depuis les années 2000 ont en général les mêmes caractéristiques. Elles associent des États et des institutions régionales (telles que l'Union économique et monétaire ouest-africaine (UEMOA) ou la Communauté économique des États d'Afrique de l'Ouest (CEDEAO) en Afrique de l'Ouest), des firmes, des centres de recherche et des universités, et des organisations de producteurs autour d'un objectif commun (Issala et Inter-

réseaux, 2017). Dans le cas de la Nouvelle Alliance, il s'agit d'attirer l'investissement privé pour développer le secteur agricole en Afrique de Scaling Up Nutrition, de la Food Fortification Initiative ou encore de l'Alliance pour l'industrie semencière en Afrique de l'Ouest. Les objectifs sont respectivement de lutter contre la malnutrition, d'améliorer la santé par l'enrichissement des produits céréaliers industriels ou d'accroître la production, la distribution et l'utilisation de semences certifiées.

L'émergence de ces « plateformes multi-acteurs » est parfois présentée comme une réponse aux lenteurs du multilatéralisme. Basées sur une approche « volontariste », elles sont censées offrir plus de réactivité et de pragmatisme, élargir la participation aux politiques publiques à une plus grande diversité d'acteurs et permettre de mobiliser davantage de financements (Aubert, à paraître).

Derrière la multiplication des alliances multi-acteurs on retrouve toutefois une poignée de firmes multinationales de l'agro-alimentaire, comme le montre le schéma ci-dessous. Le pouvoir normatif de ces grandes firmes est d'autant plus important que le secteur de l'agro-alimentaire est de plus en plus concentré (six firmes contrôlent 60% du marché mondial des semences et 75% du marché des pesticides, quatre firmes se partagent 90% du commerce mondial des céréales) (Ipes-Food, 2017).

Figure 1. Les multinationales au sein des plateformes multi-acteurs



Adapté de Aubert (à paraître). Voir la data visualisation en ligne : bit.ly/alliancebds27

Les multiples plateformes et alliances segmentent les enjeux de la SAN en formulant des objectifs techniques auxquels il convient de répondre (augmenter l'investissement privé dans le secteur agricole, accroître l'utilisation de semences certifiées, développer la fortification alimentaire, etc.). Cette approche techniciste est particulièrement propice au secteur privé international qui se présente comme porteur de solutions pour résoudre les défis techniques. C'est notamment le cas des fondations Gates et Rockefeller qui promeuvent les innovations

fondées sur la science (*science-based innovations*) pour apporter des solutions aux défis de longue date perçus comme mettant en péril la sécurité alimentaire (Stevenson, 2014).

Malgré cette fragmentation de la gouvernance, la très forte connexion entre les acteurs et la déclinaison de ces initiatives aux différentes échelles territoriales assure la diffusion d'une vision commune. L'imbrication des acteurs est particulièrement forte au niveau des plateformes plus « techniques », comme celles consacrées aux engrais ou aux semences. Pour ce qui est des engrais, Yara est ici encore un bon exemple. L'entreprise norvégienne est impliquée dans le financement de l'organisation internationale IFDC (Centre international pour le développement des engrais), basée aux États Unis, et chargée de la promotion de l'utilisation des engrais. Cette organisation internationale, soutenue par ailleurs par la coopération néerlandaise et l'Agence des États-Unis pour le développement international (USAID), développe en Afrique de l'Ouest, dans le cadre du PRIA (Programme régional d'investissement agricole de la Cedeao), le projet « Marché régional des intrants (MIR +) ». Yara est aussi indirectement impliquée dans l'African Fertilizer and Agribusiness Partnership (AFAP), créé avec un financement initial de 25 millions de dollars de la Fondation AGRA, et soutenu également par le NEPAD, l'IFDC, la BAD et l'AGMARK (Agricultural Market Development Trust). IFDC, AFAP et USAID sont les principaux partenaires de la CEDEAO dans l'animation du Forum des parties prenantes de la filière engrais en Afrique de l'Ouest.

La déclinaison de ces plateformes multi-acteurs aux différentes échelles (internationale, continentale, régionale, nationale) assure la cohérence à tous les niveaux des choix politiques et des investissements et permet aux firmes internationales d'exercer une influence jusqu'au niveau national. L'Alliance autour des semences illustre bien cette articulation cohérente et complémentaire des quatre niveaux d'intervention. Les firmes semencières sont impliquées dans l'édiction des normes internationales (UPOV 1991 ; Traité international sur les ressources phyto-génétiques pour l'alimentation et l'agriculture ; codex alimentarius). Elles sont en lien avec le niveau continental à travers l'Agence pour la mise en œuvre du Programme semencier de l'Union africaine (AfricaSeeds). Elles soutiennent et participent à l'Alliance pour l'industrie semencière en Afrique de l'Ouest (ASIWA) qui vise la « construction d'une plateforme durable, inclusive, effective pour faire le plaidoyer et agir sur les questions clés nationales ou régionales du développement du secteur semencier afin d'accroître la production, la distribution et l'utilisation de semences certifiées en Afrique de l'Ouest » (USAID *et al.*, 2014). Enfin les entreprises et les fondations qui leur sont plus ou moins directement liées sont impliquées dans les réformes réglementaires régionales. C'est par exemple le cas de la définition et de la mise en œuvre du règlement semencier régional de la CEDEAO, à travers le WASP porté par le CORAF et financé par l'USAID (Issala et Inter-réseaux, 2017).

C'est ainsi paradoxalement à l'heure où les concepts de participation et d'inclusivité du dialogue sur les politiques font consensus que la gouvernance agricole et alimentaire se

restructure autour d'une logique descendante (*top/down*) : les normes sont établies au niveau international et déclinées ensuite aux différentes échelles régionales puis nationales.

La diffusion d'un paradigme du développement agricole, qui peine à être mis en débat

Les initiatives des dernières années, l'évolution de la gouvernance de la SAN et le discours pro-secteur privé ont favorisé la diffusion d'une certaine vision du développement agricole pariant essentiellement sur les préceptes de la Révolution verte et les capacités des grandes firmes privées. Si cette vision est remise en cause par de nombreux acteurs, elle n'en reste pas moins le paradigme dominant. Plusieurs hypothèses sont formulées pour tenter de l'expliquer.

Une seconde Révolution verte

Nombre d'initiatives lancées suite à la crise de 2007-8 et impliquant le secteur privé partagent une même vision du développement agricole et de la lutte contre la faim en Afrique. Cette vision est centrée sur un modèle type « Révolution verte », basée sur une intensification par la mécanisation, l'artificialisation des processus de production, et la recherche variétale orientée vers l'augmentation des rendements (Issala et Inter-réseaux, 2017).

Sur ce point, les fondations philanthropiques ont joué un rôle important. Entre 1999 et 2009, la Fondation Rockefeller a dépensé 150 millions de dollars pour reproduire l'expérience de la Révolution verte sur le continent africain. Sa stratégie a reposé sur quatre piliers : le financement de la recherche agricole (semences améliorées, engrais, biotechnologies) ; la fourniture de formations aux paysans et aux commerçants pour l'utilisation et la distribution de semences ; le développement d'industries soutenant la promotion de systèmes agricoles dépendant des intrants à travers des partenariats public-privés; et enfin la constitution d'instances de gouvernance réunissant dirigeants politiques, experts et acteurs privés (Stevenson, 2014).

En 2006, les fondations Rockefeller et Gates ont créé l'Alliance pour une révolution verte en Afrique (Agra), aujourd'hui également financée par d'autres fondations, des entreprises privés, des organisations internationales et des agences et banques de développement. Agra a déjà financé des projets dans une dizaine de pays africains, portant en particulier sur le développement et la commercialisation de semences hybrides à des prix abordables pour les petits producteurs. De 2007 à 2016, elle a ainsi développé 562 variétés de semences et produit 602.734 mégatonnes de semences (Agra, 2016). Les projets soutenus doivent permettre de démontrer "par les faits" que certaines options de développement fonctionnent et devraient être prises en compte par les politiques publiques afin de changer d'échelle.

Si cette « Révolution verte » datant de l'expérience des pays asiatiques dans les années 1960 est toujours mobilisatrice, c'est qu'elle a évolué vers l'idée d'une « seconde Révolution verte

» capable de faire face aux défis du changement climatique, de la raréfaction des ressources naturelles et de la pression démographique. Le concept d'agriculture intelligente face au climat (*climate-smart agriculture*), promu notamment par la FAO, illustre ce positionnement. La technologie doit ainsi permettre de répondre à la demande tout en limitant les impacts négatifs sur l'environnement, à travers l'amélioration variétale et l'utilisation des technologies de l'information et de la communication.

L'édition 2019 du Forum africain pour la révolution verte (AGRF), consacré à « l'agriculture digitale », est révélatrice de ce parti pris technophile. Créé en 2010 par Agra et Yara, ce forum se présente comme « la première plate-forme permettant aux dirigeants de toute l'Afrique et du monde entier de faire avancer des plans concrets et de partager des connaissances afin d'exploiter l'énorme potentiel de l'agriculture pour favoriser une croissance équitable et durable sur tout le continent » (AGRF, 2019). En 2019, il a rassemblé 2 400 délégués venus de 89 pays et s'est clôturé sur des engagements de plus de 200 millions de dollars. Ces engagements portent notamment sur l'amélioration de l'accès des agriculteurs aux solutions numériques pour rendre l'agriculture africaine « plus productive, plus rentable, plus durable et plus inclusive ».

Une vision critiquée… mais largement dominante

Même de seconde génération, cette vision du développement agricole n'est toutefois pas sans générer un nombre important de critiques, provenant tout à la fois des organisations paysannes, des associations et ONG africaines et internationales, et d'une partie importante de la recherche. Ces acteurs pointent notamment les limites - voire les risques - de cette vision productiviste et techniciste au regard de la multiplicité des enjeux de la transformation des agricultures familiales, de la sécurité alimentaire ou de la lutte contre le changement climatique. Ils alertent sur les risques en termes d'aggravation des inégalités sociales, de pressions sur les ressources naturelles et d'accaparement des terres et mettent en avant des alternatives selon eux mieux à même de gérer durablement les ressources naturelles – comme l'agroécologie – et de répondre au défi crucial de l'emploi – comme la promotion de chaînes de valeur fondées sur des réseaux d'entreprises artisanales modernes (Bricas et Goïta, 2018; Goïta, 2014; Issala et Inter-réseaux, 2017).

Si les critiques sont aussi nombreuses et appuyées scientifiquement, pourquoi ne parviennent-elles pas à remettre en cause le modèle apparemment dominant ? Plusieurs hypothèses peuvent être avancées.

La force d'un discours simple et technique

Une des forces du paradigme porté par les grandes multinationales, c'est sa simplicité, avec des liens de causes à effets en apparence difficiles à remettre en cause : les émeutes sont liées à la faim, la faim est liée à un manque de nourriture, le manque de nourriture nécessite de produire plus.

Cette façon d'énoncer le problème aiguille vers certaines solutions au détriment d'autres. Cela conduit à exclure du processus de décision d'autres manières de conceptualiser et de répondre à un problème pourtant complexe et ne pouvant se limiter à une seule dimension (en l'occurrence la production) (voir Litfin, 1994, citée par Stevenon, 2014).

En effet, un tel discours permet de réduire l'insécurité alimentaire à un enjeu essentiellement technique demandant des réponses techniques. Les enjeux politiques qui président aux options techniques ne sont en outre pas discutées.

L'émergence du concept de planification fondé sur les preuves fait une grande place aux impacts mesurables à travers des indicateurs objectivement vérifiables. Il s'agit de partir des impacts recherchés et quantifiés afin de déterminer les actions les plus appropriées et efficientes pour les atteindre. La notion de « vérifiable » sous-entend que l'on privilégie des dimensions quantitatives mesurables (les volumes de production) et qu'implicitement les dimensions qualitatives, beaucoup plus difficiles à mesurer, sont placées au second rang, voire négligées.

Une gouvernance finalement peu inclusive?

Si le développement des plateformes multi-acteurs doit permettre d'élargir la participation aux politiques publiques à une plus grande diversité d'acteurs, force est de constater qu'aujourd'hui, la voix du secteur privé y est presque exclusivement portée par les plus grandes firmes multinationales. Pourtant, les filières agroalimentaires se structurent sur tout le continent et les entreprises privées nationales et régionales des intrants, de la transformation et de la distribution pourraient être représentées au sein de ces instances.

Au-delà de la représentativité, il est intéressant d'interroger les modalités permettant à chacun des groupes d'acteurs représentés dans ces instances de défendre leurs intérêts. Sur ce sujet, Nora McKeon oppose le fonctionnement opaque de la plupart des plateformes multi acteurs à celui du Comité pour la sécurité alimentaire mondiale au sein duquel les gouvernements conservent le pouvoir décisionnel et les autres acteurs (secteur privé, société civile, scientifiques) participent via des mécanismes de représentation différenciés. A contrario, les plateformes telles que Scaling Up Nutrition (SUN) ou l'Alliance mondiale pour l'amélioration de la nutrition (GAIN) rassemblent les différentes catégories de participants dans le même espace sans distinction des rôles, des responsabilités et des intérêts promus. Elles risquent dès lors de favoriser la voix des acteurs les plus outillés et de renforcer les asymétries de pouvoir (McKeon, 2018), d'autant que les modalités de décision y sont bien souvent opaques. Pour certains observateurs, ce type d'instances s'apparente à la rencontre de David et Goliath : « Les petits exploitants peuvent-ils vraiment faire entendre leur voix face au pouvoir de négociation collective de Bunge, Cargill, Coca-Cola, Diageo, DuPont, Unilever et Walmart - quelques-unes des 28 entreprises partenaires à l'origine de l'initiative [Nouvelle vision pour

l'agriculture] ? » (Nally et Bhaskar, 2013). De nombreux rapports recommandent ainsi de reconnaître les déséquilibres dans les rapports de forces et de trouver des moyens d'y remédier (Saarinen *et al*., 2017 ; HLPE, 2019).

Des acteurs locaux insuffisamment armés?

Face à des firmes particulièrement outillées les organisations paysannes et la société civile africaine n'ont en outre pas toujours les capacités de structuration et de plaidoyer pour se faire entendre. Ces faiblesses sont en partie liées à des difficultés intrinsèques à ces acteurs, mais aussi aux revirements au sein des bailleurs qui les soutiennent. La quasi-totalité des organisations paysannes dépend en effet de financements extérieurs, en particuliers issus de la coopération internationale. Dès lors, elles sont dans une certaine mesure contraintes d'adapter leurs priorités aux opportunités qui se présentent – et ainsi de s'adapter continuellement aux concepts successivement « en vogue » chez les bailleurs de fonds. Plus particulièrement, leurs activités de plaidoyer sont pour l'essentiel financées dans le cadre de projets dont la durée dépasse rarement cinq ans.

Les acteurs locaux du développement rural soulignent l'importance de bâtir des alliances stratégiques et de construire une intelligence de la veille qui dépasse le cadre national afin de mieux anticiper les évolutions politiques qui se dessinent de plus en plus souvent en amont. Il leur paraît essentiel d'améliorer la qualité des contributions des organisations paysannes et organisation de la société civile, sur la base d'évidences (de chiffres et d'analyses), pour convaincre les pouvoirs publics et la communauté internationale de l'intérêt socioéconomique des modèles promus (Inter-réseaux, 2019).

La position ambivalente des pouvoirs publics

Le déplacement des centres de décision vers des plateformes et alliances réunissant des acteurs aux intérêts et aux capacités d'influence extrêmement hétérogènes rend encore plus essentiel le rôle des pouvoirs publics comme régulateurs et comme garants de l'intérêt général. Les acteurs privés, qui représentent une ressource financière précieuse, sont dotés d'une rationalité qui reste a priori, malgré l'idéal de conciliation entre biens communs et intérêts privés véhiculé par certains, différente de celle d'une collectivité ou d'un État, dont l'objectif premier devrait être le bien-être social et économique de ses populations.

Le problème, c'est qu'il existe parfois un décalage important entre les capacités techniques, humaines et financières des géants de l'agro-industrie et celles des États et de leurs institutions. Le secteur privé international intervient en appui aux États et aux institutions en développant du conseil technique et juridique, face auquel ils ne sont pas armés. Par exemple, Agra intervient directement dans la formulation et la révision des politiques et réglementations agricoles en Afrique. Elle agit par le biais de « points nodaux d'action politique » qui rassemblent des experts et les « parties prenantes » pour agir au niveau national sur des domaines spécifiques. Au Ghana, le groupe de travail d'Agra sur les

semences a rédigé des révisions de la politique semencière nationale qui ont été soumises au ministère de l'Alimentation et de l'Agriculture (Agra, 2013).

En outre, la volonté affichée de certains États d'attirer les investissements des grandes entreprises privées les met dans une position parfois compliquée de régulation des rapports de force et de garant de l'intérêt commun. Comme le soulignent Gabas et ses collaborateurs, la capacité des fonds publics à orienter les investissements privés a en effet ses limites et la négociation des objectifs "conduit nécessairement pour les pouvoirs publics à des compromis qui contribuent à remettre en cause une partie de leurs choix politiques et, par voie de conséquence, de leur souveraineté" (Gabas *et al*., 2017).

Au-delà de ces tensions, certains auteurs dénoncent une certaine collusion entre acteurs privés et élites publiques, deux sphères finalement assez poreuses qui parlent la même langue et appartiennent souvent au même monde.

Les contre-savoirs comme contre-pouvoirs

Enfin, la crise du financement public de la recherche internationale et africaine prive l'Afrique d'une production scientifique indépendante, en capacité de jouer un rôle de contrepouvoir.

Cette faiblesse de la recherche publique africaine ouvre ainsi la porte aux acteurs privés dont les priorités de recherche sont fortement orientées justement vers les piliers de la Révolution verte. Les fondations sont en effet particulièrement engagées dans la recherche agricole avec un apport total de 7,7 milliards de dollars entre 2013 et 2015 (OCDE, 2018). Les recherches financées par les fondations privées liées à des firmes – qu'il s'agisse de la fondation Gates, la fondation Syngenta ou encore l'African agricultural technology foundation (AATF) - portent en premier lieu sur les intrants agricoles, en particulier les semences (notamment hybrides et OGM) (Swanby, 2015).

La formation de réseaux d'experts, agronomes, agro-économistes, biologistes, en particulier à travers le CGIAR, a en outre constitué des "communautés épistémiques" qui ont diffusé une certaine manière d'aborder le développement agricole et la sécurité alimentaire dans les pays en développement (Stevenson, 2014).

Conclusion

L'évolution de la gouvernance de la SAN illustre de manière particulièrement éloquente la nature mutuellement constitutive du savoir et du pouvoir (Susan Owens, 2015). Le discours néo-libéral qui fait du secteur privé un acteur incontournable de la fourniture des biens publics a donné naissance à une nouvelle architecture de la gouvernance de la sécurité alimentaire et nutritionnelle. Cette gouvernance, hybride et fragmentée, où le secteur privé international

jouit d'une influence particulièrement importante, favorise la diffusion d'un certain paradigme du développement agricole, techniciste et productiviste. Pour remettre en débat le paradigme dominant sur la transformation des agricultures africaines, il est nécessaire de s'interroger sur les modalités d'une gouvernance véritablement inclusive. Une plus grande transparence sur les modalités de participation et de décision au sein des plateformes multi-acteurs, le renforcement des acteurs locaux, le rôle de régulateur des pouvoirs publics, et une recherche indépendante sont essentiels pour construire des contre-pouvoirs et des contre-savoirs et démocratiser les systèmes agricoles et alimentaires.

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Does participation of agricultural entrepreneurs in knowledge networks improve firm performance in Benin?

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Knowledge network is a key element of the entrepreneurship environment. It is claimed to provide entrepreneurs with information, resources, and knowledge likely to positively impact the performance of their firms. In the African context, where agricultural entrepreneurship is rapidly evolving in adverse conditions, knowledge networks are presumed to be critical for entrepreneurs. However, it is still unclear if and how knowledge networks can improve the performance of firms. This study empirically investigated that question in Benin where 819 agricultural entrepreneurs were interviewed. Descriptive statistics were used to evidence the participation in knowledge networks, and an ordinal logistic regression to assess the effect of participation on the firm's performance. Findings showed that agricultural entrepreneurs use both formal and informal knowledge networks with more intensity towards the informal ones. Participation in these knowledge networks is influenced by age, gender, education level, and sector of activities. Moreover, entrepreneurs who can access advice or information on resources from organizations in their networks or actively participate in professional events displayed higher performance. This study provides critical information for institutions that are active in encouraging or crowding out the involvement of the private sector in agricultural and rural development.

Keywords: private sector; knowledge networks; agricultural development; entrepreneurs; Benin

Introduction

The private sector has been increasingly called upon to play a more active role in agriculture and food systems, in a context where at the global level, more than 820 million people have insufficient food for a healthy life and 2 billion facing malnutrition in its different forms (Willett et al. 2019, Scott 2017). Among other strategies, small and medium agribusinesses are expected to participate in knowledge networks (KN) by connecting with more stakeholders active in creating and supporting a conducive environment for the development of agricultural and food systems for better food and nutrition security. KN refers to any

collaborative activity involving the sharing of information between humans, either formal or informal. Its mandate is to generate and disseminate information, either based on research, opinions, or experiences. KN as a key vehicle for knowledge transfer and diffusion affects the innovative performance of firms (Boschma and Ter Wal 2007) and is widely recognized to provide entrepreneurs with assets and *in fine* to affect their business (Greve and Salaff 2003).

Indeed, entrepreneurs can use KN to obtain or co-create knowledge about anything of importance to their economic activity including capital, advice, markets, capacity building, and technologies (Hartwich et al. 2007). Thus, KN are expected to provide entrepreneurs with information and knowledge likely to make a difference in their daily business decisions. However, beyond the generic added values of KN, it is still unclear how and in what contexts the expected outcomes of connecting to KN are delivered. Such questions are particularly relevant in developing countries and especially in Africa for two reasons. First, because Africa is with no doubt in need of strong and effective KN. Indeed, while the entrepreneurial dynamic in Africa is rapidly evolving (Jones et al. 2018) with the continent having the highest entrepreneurship rate in the world (AfDB 2017), it also has the highest small business discontinuance. Second, because Africa offers a socio-political context that may vampire and alter the efficiency of KN. Indeed, entrepreneurship in Africa is evolving in an extremely fragile environment (i.e. high unemployment rate, distrusts of actors, corruption, predominance of informality, unclear fiscal policies, etc.). Thus, the benefits that may result from the participation of African entrepreneurs in KN are unclear. Agricultural entrepreneurs do not know if and how multi-stakeholders' collaboration can improve the performance of their businesses. This paper aims to bridge that knowledge gap and advance the debate on the effect of knowledge networks on entrepreneurship in Africa, with a focus on the agricultural sector. Using a case study of the Republic of Benin (West Africa), the paper investigated how the participation of agricultural entrepreneurs in knowledge networks can improve the performance of their businesses.

In the first step of this study, we are interested in exploring the participation of agricultural entrepreneurs in KN. In the search of knowledge, agricultural entrepreneurs may refer either to formal or informal networks. Formal networks are well-codified networking channels that have established structures and formal procedures of access. These can include organizations that provide advice, knowledge, capacity building opportunities, and information on resources such as capital and markets. To access these networks, entrepreneurs are required to follow formal procedures. In contrast, the entrepreneur also can develop an informal network that can provide the same knowledge and resources as the formal ones. These networks are mainly made of individuals that the entrepreneur has access to (Maas et al. 2013), either family members or non-family members (Arregle et al. 2015). Each entrepreneur is free to decide on which combination of informal and formal knowledge networks to establish to achieve its objectives. Because of the easiness of access to informal knowledge networks in Africa, we hypothesized that entrepreneurs may participate more in informal KN. Also, we are interested

in analyzing the entrepreneur and its business (as a node) within its environment where other actors influence its access to knowledge and resources. The value created by the social network to a node is referred to as 'social capital' which is the set of tangible or virtual resources that accrue to actors through the social structure, facilitating the attainment of the actor's goal (Greve and Salaff 2003). Social capital is used in this research as the outcome of the relationship between the agricultural entrepreneur and its knowledge network. The nature of this relationship may be affected by the characteristics of the individual and its businesses. For example, younger and less educated entrepreneurs may have limited networking capabilities than older and more educated. The gender of the entrepreneur may also affect its social capital. Therefore, we expected that participation in KN is influenced by the socioeconomic characteristics of agricultural entrepreneurs.

Second, we take an additional step to investigate the effectiveness of KN in improving firm performance. In this research, firm performance is estimated through revenue growth. The social capital generated by the entrepreneur through its relationship with its knowledge networks can provide information, capital, skills, and market opportunities to start and expand business activities. By way of example, agricultural entrepreneurs need information about agricultural technologies and capital to identify and pursue business opportunities. They also need advice on the management of their businesses that their knowledge networks can provide. As such, the presence of knowledge networks can be a comparative advantage as information pulled from it can positively impact firm performance (Pratono 2018). Therefore, we expected that an increased degree of participation in KN has a positive impact on firm performance.

The paper is structured into five sections. Section 2 presents the methodology through the study area, the sampling method, and data collection and analysis. Section 3 presents the results through the participation of agricultural entrepreneurs in knowledge networks, the socioeconomic factors that influence such participation, and the influence of knowledge networks on firm performance. Section 4 discusses the findings in light of academic literature and provides implications for policy and practice. Finally, the limitation of the study, avenues for future researches, and general conclusions are provided.

Methodology

Study area

Although its contribution to the country's gross domestic product (GDP) has been falling in the past years, agriculture is still an important sector for Benin's economy. Its contribution to GDP moved from 25.23% to 22.64% from 2006 to 2018 whilst in nominal terms, it has increased from $US 1.44 to $US 2.18 billion during the same period (World Bank 2019). The agricultural sector is dominated by smallholder farmers who conduct their agricultural

activities mainly in a family context. However, in the last decade, there has been a surge in what is coined as "agricultural entrepreneurship" to denote the risk-taking behavior to launch firms in the agricultural sector with the central aim to satisfy a perceived demand and generate revenue. Different programs driven by governments or development partners have established initiatives that create incentives for people especially the youth to start a business in the agricultural sector. The main objective pursued is the reduction of youth unemployment.

To succeed, the entrepreneurs make use of the available resources they can access. Some of these resources are accessed through the networks that the entrepreneur has access to. In the national context, there are public and private organizations that offer different kinds of resources to entrepreneurs. These can include advice and coaching for business management, information on different resources such as capital and markers, knowledge, and capacity building on various thematic of interest for the entrepreneurs. There are also professional events of different nature that entrepreneurs can attend to expand their network and knowledge about their business sector. Informally, entrepreneurs also refer to individuals within their network to access the same resources. Finally, agricultural entrepreneurs are also actively motivated to join professional associations that are either thematic- or region- based. Many of these professional associations are structured to be connected to an apex national platform that defends their interests mainly with policymakers.

Sampling method and data collection

To ensure the representativeness of all segments of the agricultural entrepreneurship phenomenon, a stratified random sampling approach was adopted. The strata were the three agricultural sub-sectors namely: primary production, processing, and services. Within each stratum, a random sample was selected. In total, out of a sample frame of 2,029 agricultural entrepreneurs from southern Benin where the agricultural entrepreneurship ecosystem is more vibrant, 819 agricultural entrepreneurs were surveyed between October and December 2019. Data were electronically collected using Kobo Toolbox. The questionnaire was made of sections to assess the level of networking of agricultural entrepreneurs mainly in terms of knowledge acquisition (information about capacity building and resources such as capital and markets) and to estimate the performance of their firms.

At a first step, data were collected about the structure of the networks of entrepreneurs and the intensity of their networking activity. Specifically, entrepreneurs indicated which of the following networking activities they undertake: *Membership in a professional association, Relationship with organizations for advice, Relationship with organizations for information on resources, Relationship with organizations for knowledge and capacity building, Relationship with individuals for advice, Relationship with individuals for information on resources, and Participation in professional events*. For each of these activities, data were collected on their intensity. Specifically, the number of memberships in professional associations was indicated; the number of organizations and individuals with whom the

entrepreneurs had had contacts in the past 6 months and the number of professional events attended in the past 12 months was collected. Thus, we have seven independent variables: number of memberships in professional associations, number of relationships with organizations for advice, number of relationships with organizations for information on resources, number of relationships with organizations for knowledge and capacity building, number of relationship with individuals for advice, number of relationships with individuals for information on resources, and number of professional events attended.

Second, data were collected on the performance of the firms. Firm performance is commonly assessed with revenue (sales) growth (Arregle et al. 2015, Brüderl and Preisendörfer 1998). In the national context, entrepreneurs tend to be reluctant in disclosing their exact annual sales either because they do not keep accurate records of their revenue or they do so to avoid taxes. Therefore, we asked entrepreneurs to indicate in which interval their annual sales may fall. These data were collected for the last 4 years (2018, 2017, 2016, and 2015). Five intervals were proposed (in XOF): less than 2,000,000; 2,000,001 – 5,000,000; 5,000,001 – 10,000,000; 10,000,001 – 20,000,000; and more than 20,000,000 (USD/XOF = 604 as of May 1st, 2020). Movements between intervals were taken as an indication of positive or negative firm performance. To calculate an overall comparable growth over the four years, the multi-year growth rate was computed (Equation 1).

Equation 1: $Average\ annual\ growth\ (\%) = 100\ x\ (\sum \frac{Revenue\ in\ year\ t - Revenue\ in\ year\ t-1}{Revenue\ in\ year\ t})/T$

where T is the duration (years) between initial and final years.

Entrepreneurs were classified in three ordinal categories: “Decline of revenue” for those with a negative growth rate, “Stable revenue” for those with a growth rate that equals to 0, and “Growth of revenue” for those with a positive rate.

Since firm performance is affected by other factors beyond networking activity, data collection was extended to other variables (control variables) known to influence the performance of the firms. These variables include:

- gender as the sex of the entrepreneur (Lee and Marvel 2014);
- human capital (Arregle et al. 2015), comprising of the age of the entrepreneur (in years), and his/her education level (no education, primary, secondary and university);
- the firm age (in years) (Arregle et al. 2015);
- the firm size operationalized in terms of the number of full-time employees (Arregle et al. 2015);
- the agricultural sub-sector in which the firm operates (primary production, processing, and services); and

– the entrepreneurship environment assessed by the level of access to finance as capital (Fowowe 2017)

Table 1: General characteristics of agricultural entrepreneurs

		%			%
Gender	Female	25.15	**Formal**	Yes	48.35
	Male	74.85		No	51.65
Age	Young (≤ 35years)	43.83	**Business size (Revenue 2018 in XOF)**	Less than 2,000,000	37.14%
	Adult (35-60years)	49.45		2,000,001 – 5,000,000	28.11%
	Old (> 60years)	6.72		5,000,001 – 10,000,000	17.69%
Education	No education	9.04		10,000,001 – 20,000,000	7.65%
	Primary	12.33		More than 20,000,000	9.41%
	Secondary	33.21	**Growth-oriented**	Yes	95.60
	University	45.42		No	4.40
Employment status before starting the business	Not employed	76.07	**Business location**	Urban	55.19
	Employed	23.93		Rural	44.81
Agricultural professional training	No	51.16	**Sector**	Primary production	44.69
	Yes	48.84		Agricultural processing	39.93
Experience in entrepreneurship	No	87.55		Agricultural services	15.38
	Yes	12.45	**Sample size**		819
			Number of municipalities covered		40

Interviewed agricultural entrepreneurs were dominated by men; only 1 out of 4 entrepreneurs was a woman (Table 1). Individuals who were less than 60 years old made more than 90% of agricultural entrepreneurs with almost half of them being young (below 35). As for the education level, agricultural entrepreneurs had a relatively higher level as almost half of them had a university level. Only 9 percent did not attend any formal education. Before starting

their business, agricultural entrepreneurs were mostly unemployed (76%). In terms of background, almost half of agricultural entrepreneurs attended agricultural professional training but only 12% have had experience in entrepreneurship before starting their business.

Regarding the agricultural businesses, half of them were not formal; formalization in this context referred to registration with GUFE (*Guichet Unique de Formalisation des Entreprises*), a one-stop-shop for formalization. In terms of business size, the survey focused on small and medium enterprises as 90% had annual revenue of less than XOF 20,000,000 (USD 33,085) in the year before the survey. More than 95% of agricultural businesses are growth-oriented. Regarding the geographical location of the businesses, there were more businesses located in urban areas (55%) than in rural areas. As for the sub-sector of operations, most businesses operated in primary production (44%) and processing (40%) sub-sectors. Few businesses were operating in the services sub-sector (15%). In short, this study focused on the for-profit private sector in the agricultural sector and especially on small- and medium-sized businesses.

Data analysis

Participation of agricultural entrepreneurs in knowledge networks

The proportions of agricultural entrepreneurs engaged in each type of networking activity were calculated. Through a Venn diagram, the different combinations of networking activities were displayed. To analyze the profiles of agricultural entrepreneurs about their networking activities, we computed the frequencies of each type of networking activity in the function of the socioeconomic characteristics of the entrepreneurs, and we used the Pearson chi-squared to test any significant relationship. Finally, percentiles were calculated to analyze the intensity of networking activities by agricultural entrepreneurs.

Effect of an increased degree of participation in knowledge networks on firm performance.

At a first stage, we calculated the frequencies of the presence/absence of each type of networking activity by the growth category. This was instrumental in displaying a general trend about how each type of networking activity univariately influences the performance of the businesses. Thereafter, we analyzed the combined effect of the networking activities by fitting an ordinal logistic regression as the dependent variable "firm performance" is ordinal. Ordinal regression is used to predict an ordinal dependent variable (in our case the 'firm performance') given one or more independent variables.

Results

Participation of agricultural entrepreneurs in knowledge networks

Agricultural entrepreneurs mentioned seven networking channels which could be assumed to be related to KN (Figure 1). The most cited networking channels include professional

associations, organizations, individuals, and professional events (Figure 1). Agricultural entrepreneurs collaborated with organizations and individuals mainly to get advice on managing their businesses and information on resources such as market and capital. In addition to that, they also looked for capacity building opportunities from organizations.

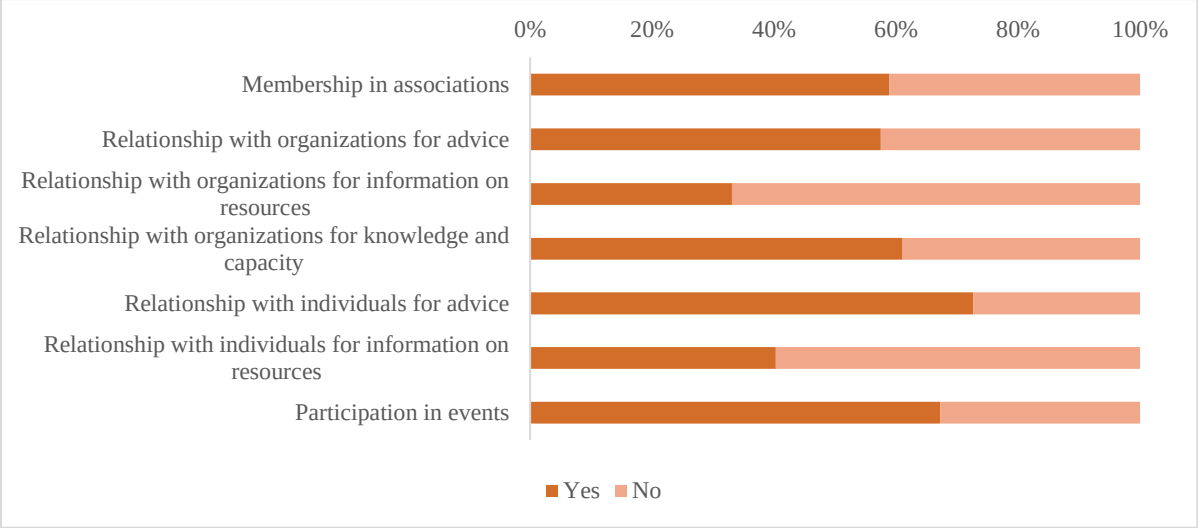

Figure 1: Networking activity of entrepreneurs

Entrepreneurs undertook specific combinations of these networking channels to form their KN (Figure 2). The largest combinations made by entrepreneurs is “Organizations + Individuals” (set by 63% of entrepreneurs), and “ Organizations + Events” (set by 59% of entrepreneurs) meaning that more than half of agricultural entrepreneurs not only referred to organizations to access knowledge but also actively participated in professional events or refer to individuals. It is important to highlight that 40% of surveyed entrepreneurs include the four elements in their network.

The identified KN can be grouped in two broad categories based on the level of formality namely formal and informal channels. The formal KN includes professional associations and organizations. The basic KN was through professional associations (60% of entrepreneurs are members of associations). These associations are formalized groups of agribusiness owners operating in the same geographical area or along the same agricultural value chains. Professional associations can be either solely or connected to a larger association that covers a larger geographical area or operates at a higher level of the value chains. In addition to their membership in professional associations, agricultural entrepreneurs also created functional linkages with organizations for different purposes. Most entrepreneurs collaborated with organizations to get knowledge and capacity building (61%), advice (58%), information on resources - capital and markets for example – (33%). Beyond formal channels, agricultural entrepreneurs also integrated informal KN mainly made of individuals that provide either advice or information on resources. Of the 819 entrepreneurs surveyed, 70% and 40% had

reported the presence of individuals in their KN to get advice and information on resources, respectively. Based on this univariate analysis, there is evidence that agricultural entrepreneurs establish more informal networking activities (with individuals) than they do formally (with organizations).

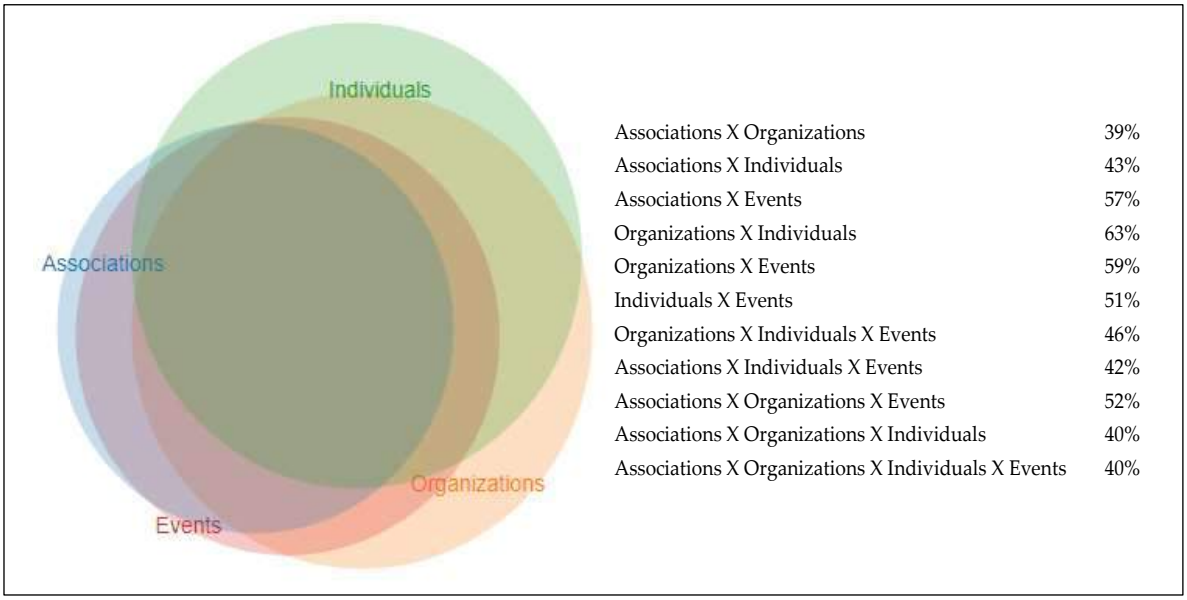

Figure 2: Diversity of networking activities among agricultural entrepreneurs

In addition to the networking channels discussed above, agricultural entrepreneurs also participated in professional events to extend their networks. Two out of three entrepreneurs have reported that they attended on average at least one professional event in a year. Beyond participating in a KN, the intensity of activities among those who were engaged in at least one form of networking varies within the interviewed agricultural entrepreneurs (Table 2). Three out of four agricultural entrepreneurs who were a member of a professional association, registered with only one association, while the rest was a member of more than one association. Agricultural entrepreneurs had in their network more organizations for advice than for information on resources. Indeed, 75% of agricultural entrepreneurs had three or fewer organizations in their KN for advice and two or less for information on resources. For the same purpose, entrepreneurs engaged more with individuals than with organizations. Regarding events attendance, half of the agricultural entrepreneurs who were engaged in such KN attended at most six events a year, which represents two events every two months showing a high intensity of networking. About 20% were engaged in an even higher intensity of networking, having attended between 12 and 24 professional events a year.

Effect of socio-economic characteristics of entrepreneurs on their participation in knowledge networks

The knowledge networking activities of agricultural entrepreneurs were observed along with their socioeconomic characteristics. Participating in “professional associations” varied

significantly with age (p=0.001), level of education (p=0.002), sector (p=0.017) and gender (p=0.030). Indeed, as the age of the entrepreneur increases, there was a greater likelihood for the entrepreneur to be a member of a professional association. For example, 69% of old entrepreneurs (>60 years) were a member of a professional against 64% and 52% for adults (35-60 years) and young entrepreneurs (<35 years) respectively. As for education, 80% of those who had a membership with a professional association had either secondary (37%) or university level (43%). Regarding the sector, entrepreneurs who operate in primary production were the most represented in professional associations (63%) and those in the services sector were the least represented (49%). As for gender, male entrepreneurs were more represented in professional associations (61%) than women (52%).

Table 2: Intensity of networking activities among agricultural entrepreneurs

Variable	Obs.	Mean	Std. Dev.	Min	Max	Percentile (%)			
						25	50	75	95
Associations	445	1.31	0.62	1	5	1	1	1	3
Organizations for advice	471	2.15	1.66	1	15	1	2	3	5
Organizations for information on resources	271	1.76	1.27	1	10	1	1	2	4
Organizations for knowledge and capacity	478	1.74	0.99	1	7	1	1	2	4
Individuals for advice	588	3.82	3.50	1	25	2	3	5	10
Individuals for information on resources	329	3.18	3.32	1	30	1	2	4	8
Events	531	7.83	5.96	1	24	3	6	12	24

Collaboration with organizations was shown to be influenced neither by the gender of the agricultural entrepreneur nor by the sector of activity. However, for education, it was observed that, compared to agricultural entrepreneurs with higher levels of education, entrepreneurs with no education or primary level made more use of their connections with organizations to get information on resources (p=0.003). For example, only 28% of entrepreneurs with university-level reported having received information on resources from organizations in the semester before the survey. Regarding age, young entrepreneurs are the group of entrepreneurs who made the most use of organizations in their network to get advice (62%). Adult and old entrepreneurs referred to organizations in their network to access knowledge and capacity building. Regardless of their age, few entrepreneurs made use of organizations in their network to access information on resources (p=0.007).

Participating in individual-based KN for advice varied significantly with age (p=0.000) and gender (p=0.040). Young people (80%) were the ones who referred the most to individuals for advice, followed by adults (68%) and old (55%). As for gender, women utilized their relationships with individuals to get advice more than men do. The utilization of connections

with individuals to get information on resources varied significantly only with the level of education (p=0.011). Entrepreneurs with secondary and university levels are the ones who referred the least to their connections with individuals to get information on resources.

Finally, attending professional events as a form of participation in KN varied by level of education (p=0.041) as entrepreneurs with higher education levels seemed to be more active in professional events.

Effect of participation in knowledge networks on firm performance

An analysis of the revenue of firms from the last 4 years before the survey indicated that 5.71% of firms were declared in a declining trend, while 58% were declared as stable, and 36% were declared in a growing trend. The firm performance varied with membership in professional associations (p=0.075), relationship with organizations for information on resources (p=0.000), and relationship with organizations for advice (p=0.000). Indeed, entrepreneurs who were a member of a professional association were more represented in the "Growth of revenue" group than others (Figure 3a). Similarly, entrepreneurs who had a functional relationship with organizations for advice or information on resources were less represented in the "Decline of revenue" group than in the "Stable revenue" and "Growth of revenue" group (Figures 3b and 3c).

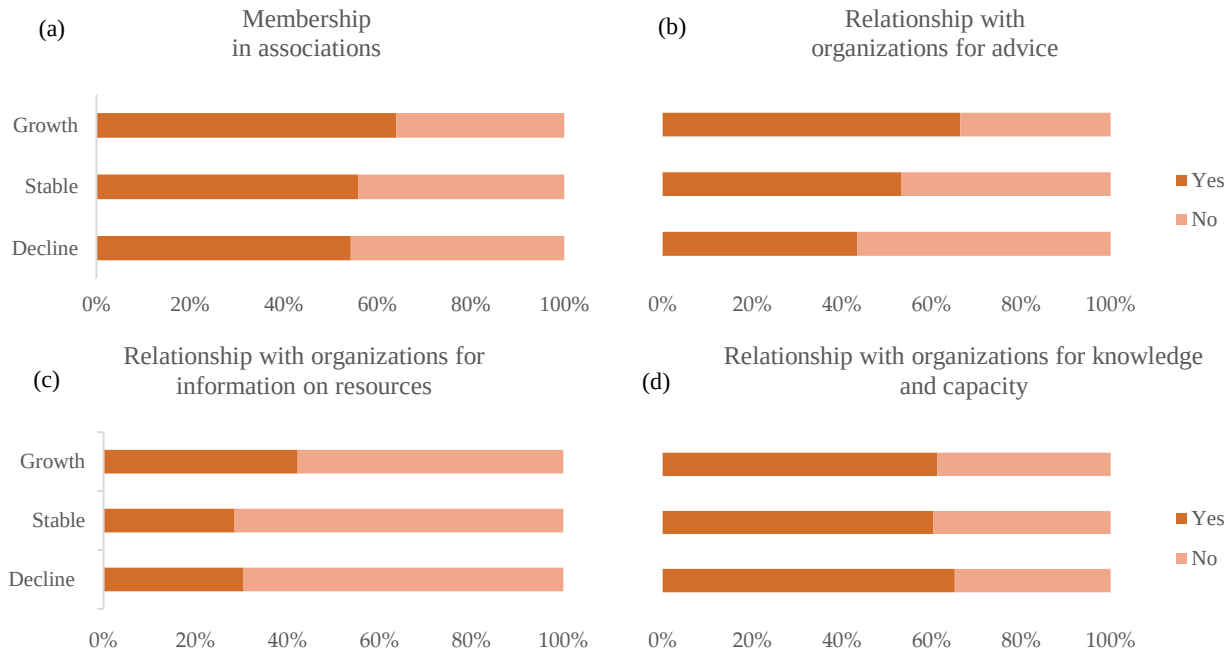

Figure 1: Formal networking activities among agricultural entrepreneurs

It is similarly the case that the entrepreneurs' relationship with individuals and participation in professional events have some bearing on the performance of the firm. The performance of the firm seemed to be influenced by the existing relationships with individuals for advice

(p=0.002) and for information on resources (p=0.025). Entrepreneurs who had a functional relationship with individuals for advice or information on resources were less represented in the "Decline of revenue" group than in the "Growth of revenue" group (figures 4a and 4b). The same trend is observed for participation in professional events.

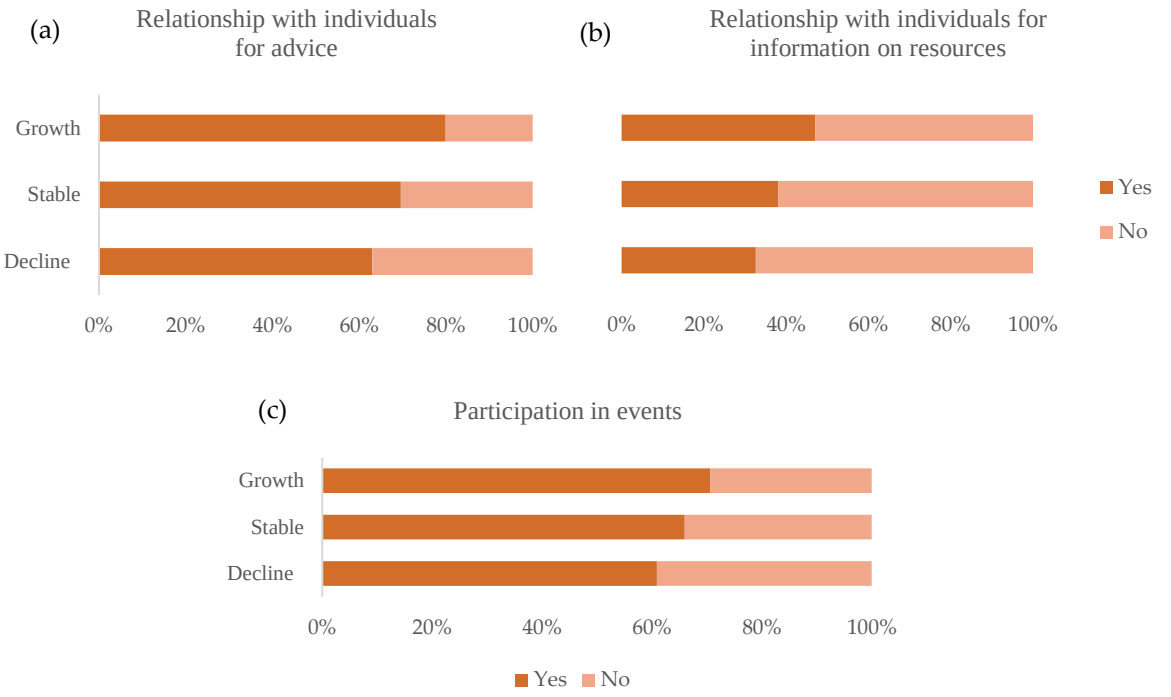

Figure 2: Informal networking activities among agricultural entrepreneurs

The ordinal logistic regression performed to analyze the combined effect of the networking activities of the entrepreneurs on the firm performance (Table 3), suggested that the intensity of activities in professional associations did not significantly affect the firm performance. However, the intensity of networking activities with organizations significantly influenced the performance of the firm. Indeed, the firms whose owners engaged in increased networking activities with organizations for advice and information on resources performed better than those who have lower networking activities. Surprisingly, we observed a significant negative coefficient for the relationship with organizations for knowledge and capacity building. In other words, the more entrepreneurs participate in networking activities that encompass elements such as training, the less their firms perform. Although the collaboration of entrepreneurs with individuals for advice and information on resources was high, the model did not show it as a significant contributing factor to firm performance. Regarding the participation in professional events, the results showed that the more entrepreneurs were engaged in such networking activities, the better their business performed.

Table 3: Effect of networking activities on firm performance

	Coef.	P>z		Coef.	P>z
Associations	0.082	0.489	**Age. Adult (35-60years)**	-0.782***	0.000
Organizations for advice	0.129**	0.035	**Age. Old (> 60years)**	-1.556***	0.000
Organizations for information on resources	0.210***	0.007	**Education. Primary**	-0.221	0.508
Organizations for knowledge and capacity	-0.213***	0.005	**Education. Secondary**	-0.279	0.349
Individuals for advice	0.016	0.544	**Education. University**	-0.160	0.606
Individuals for information on resources	-0.019	0.583	**Firm age**	-0.024**	0.013
Events	0.052***	0.001	**Firm size**	-0.004	0.694
Gender. Male	0.320	0.100	**Access to finance**	0.058	0.422
			Sector. Processing	0.042**	0.022
			Sector. Services	0.298	0.199

*** $p < 0.01$, ** $p < 0.05$ and * $p < 0.10$

Discussion

Knowledge networks are important assets for firms. They complement internal human capital by extending firm's access to additional knowledge and resources that may form a comparative advantage. In this research, we analyzed the participation of agricultural entrepreneurs in knowledge networks and how this affects the performance of their firms. The study revealed that agricultural entrepreneurs have access to about seven knowledge network channels used to acquire information, knowledge, and capacities, combining both formal and informal networks. Thus, beyond the internal knowledge network generated by the business owner and its human resources (Caloghirou et al. 2004) and extension services (Gbêhi and Leeuwis 2012) that might be considered as important sources of knowledge, agricultural entrepreneurs in Benin have access to additional external knowledge. Knowledge networking activities are mainly pursued through professional associations, organizations, individuals, and events. Participating and valuing knowledge networks are of critical importance in the African context where entrepreneurship rate is the highest in the world (AfDB 2017). Indeed, enterprises especially at the nascent phase resort less on the use of human capital investments as a source of skills and much more on self-taught skills and people in their social networks (Mamabolo et al. 2017). Therefore, institutions supporting startups in Africa should invest and facilitate access of nascent firms to knowledge network channels. They can do so by

reinforcing the capacities of those channels in the provision of knowledge services and by promoting collaboration among them.

All agricultural entrepreneurs regardless of their profiles were engaged at least in one form of KN. Entrepreneurs included in their networks both organizations and individuals to get advice, information on resources, and capacity building opportunities. Many of them also belong to a professional association. However, we found that participation in KN varies with the socioeconomic characteristics of agricultural entrepreneurs. For example, male, old, and more educated entrepreneurs who are active in the primary sector were more likely to have active memberships with a professional association. This is a clear indication that professional associations are not well inclusive in the agricultural entrepreneurship ecosystem in Benin. Beyond the visibility issue (lack of information), this low engagement of professional associations in the agricultural entrepreneurship ecosystem may be related to the geographic location and the restricted scope of these associations. For instance, professional associations are concentrated on primary production and less on processing and services. By way of example, PNOPPA-Benin (*Plateforme Nationale des Organisations Paysannes et de Producteurs Agricoles du Bénin*), the largest and most active association is mainly made of entrepreneurs in the primary sector. Also, at the national level, the primary production is the most developed segment. The services sector is still embryonic which explains the fact that they just represented 10% of the sample. Nevertheless, the processing and services sectors must increase their membership in professional associations. This will help increase collaboration among the three segments to ultimately create more added value in the sector and voice their concerns more systemically.

Beyond professional associations, entrepreneurs also actively engaged with different organizations to get advice, and information on resources such as capital and markets. The study found that the utilization of these knowledge networks varies along by type of entrepreneurs. For example, young entrepreneurs made more use of their relationships to get advice; certainly, because they have little knowledge about the management of their agribusiness activities and also several organizations like incubators and entrepreneurship programs targeting youth are offering such services. Similarly, the study found that young people were the ones who referred the most to individuals for advice. Therefore, we can conclude that advice on business management is the most preferred outcome of KN for young people. The implication is that KN that seek active participation of young entrepreneurs should make sure that they can get advice on their businesses.

Agricultural entrepreneurs made more use of their informal networks of individuals than they do formally with organizations; this is more pronounced among women. Such a finding can be explained by two factors. First, it may be an emanation of African culture that is more community-based; people have more tendency to look for information, knowledge, and support in their immediate community and network of individuals. This is even more

pronounced in contexts like the Benin one where it is generally believed that "you need to know someone to succeed. Second, it could also be explained by the fact that entrepreneurs found it more difficult to interact with formal nodes such as government organizations or entrepreneurship programs run by development agencies because of the requirements and procedures that they may have put in place. For example, admission to a mentoring program may be on a competitive basis to select just a few. This is not bad, but organizations should be cognizant of the fact that established requirements and procedures may be a barrier for agricultural entrepreneurs, especially women; so they should proactively attract them to reduce the gender gap and mainstream the concerns and perspectives of women. The participation of agricultural entrepreneurs in informal networks also implies that programs for knowledge co-creation and brokering could also consider integrating the informal networks into their processes and find innovative ways through which they can work with formal networks to increase the outcome for entrepreneurs. In practice, those individuals could be included in formal capacity building programs for entrepreneurs as mentors or resource persons.

Moreover, the study found that participation in knowledge networks positively influence firm performance, congruently to a large body of literature which reported a positive impact of knowledge networks on firm´s strategy and innovation performance (Boschma and Ter Wal 2007, Soo et al. 2004, Wang et al. 2018). However, the quality of the knowledge network matters as knowledge transfer and its outcomes depends on interacting nodes. For instance, de Zubielqui et al. (2019) concluded that knowledge transfers from suppliers (only) influence knowledge quality, and knowledge transfer from suppliers, in turn, has an indirect effect on innovation through knowledge quality. In this study, participating in a professional association does not influence firm performance. Such finding implies that professional associations offer limited high-value knowledge and resources that can be a competitive advantage for agricultural entrepreneurs. However, increased networking activities through professional events or with organizations for advice and information on resources seem to influence firm performance. This suggests that the more agricultural entrepreneurs collaborate with organizations to get advice on the management of their business, or to get information on capital and markets, the better their firms perform. Therefore, advice, and information on capital and markets, are the most important valuable resources for entrepreneurs in knowledge networks. They form the core argument to increase the participation of agricultural entrepreneurs in knowledge networks. For example, they will be more likely to devote time and resources to knowledge networks that will help them develop new products and services to the markets.

However, it is important to nuance the effect of participation in KN on firm performance. First, as it is acknowledged and mainstreamed in the econometric model, other factors affect firm performance (Arregle et al. 2015, Fowowe 2017). Therefore, scholars and practitioners should not overestimate the effect of KN on firm performance. For example, participation in

KN will better improve firms in which there is a knowledgeable human capital that can identify and select which KN channel is more beneficial to the firm and have the capacities to convert the knowledge acquired in KN into assets that can be used by the firm. As such, although agricultural entrepreneurs are advised to participate in KN, they should carefully select which knowledge network and which knowledge networking activities are the most crucial to them and effectively complement a need that was initially identified. For example, our study showed that informal knowledge networking activities with individuals seem not to influence firm performance; therefore, entrepreneurs should reduce such knowledge networking activity by carefully selecting only the ones with clear benefits. Being highly selective and strategic in knowledge networking is particularly important for agricultural entrepreneurs, as knowledge networking opportunities have become overwhelming in recent years. For example, there are more and more professional events that entrepreneurs can attend; more research projects are looking to collaborate with agricultural entrepreneurs. In such a context, entrepreneurs should be aware that the quantity should not overpass quality.

Overall, it is clear from the findings that participating in the right KN is an advantage for agricultural enterprises. As a contribution to higher performance and then likely to endogenous economic growth (Ehrlich et al. 2017), the participation of entrepreneurs in KN should be recommended and supported. Consequently, if this paper stimulates policymakers and practitioners to mainstream knowledge networks' perspective into support to increased contribution of the private sector to agricultural development, then it will have achieved its broader objective.

Limitations

This study was carried out at the national level. Though it offered the possibility to conduct context-specific analyses, it also failed to consider cross-country heterogeneity. Future research could be implemented at a regional level to control for country variability and generate more generalizable findings. A second limitation is related to the measure of firm performance. Although the approach adopted by the study is an acceptable approximation of the performance of businesses, it would be more accurate to use actual reliable sales figures and production/operating costs.

Conclusions

This study explores the participation of agricultural entrepreneurs in knowledge networks and their impact on firm performance. Agricultural entrepreneurs demonstrate complex and strong networking activities, valuing both formal and informal networking channels to acquire information, knowledge, resources, and capacities. The agricultural entrepreneurship landscape in Benin indicates a rich ecosystem of about seven knowledge network channels that complement the knowledge creation processes within the firm. Such networks are

instrumental in interactive learning and innovation. The study also demonstrates that being in the right knowledge network is of utmost importance. Indeed, not all knowledge networks have a positive impact on the performance of the firms. Moreover, the magnitude of the effects varies with networking activities. Overall, participating in knowledge networks is an asset for the performance of the firms and *in fine* for their growth. However, the added value of knowledge networks should not be overestimated; it contributes to firm performance along with other important factors.

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CASE STUDY

Knowledge as catalyst: using knowledge exchange and learning to commercialize a public agricultural research idea for Kenyan and Rwandan smallholder farmers

Laura Harwig and Laura Ostenso

Actors involved in developing and scaling agricultural technologies in developing countries – specifically publicly funded research institutions and private sector businesses – operate according to different sets of motivations and perspectives. Their objectives, however, can be complementary and, with the right incentives, align to create synergies leading to innovative products and services for smallholder farmers. The exchange of knowledge among these actors plays a catalytic role in aligning motivations, perspectives, and objectives to advance innovations. Its role can aid in the initial stages of shaping public agricultural research priorities to the later stage of scaling-up a resulting product, service, or technology through commercialization. This case study illustrates this dynamic in a multi-year agricultural technology partnership between Feed the Future Partnering for Innovation, a United States Agency for International Development (USAID)-funded program implemented by Fintrac Inc., and Purdue University. The partnership aimed to scale use of an improved grain storage bag, known as PICS (Purdue Improved Crop Storage), to reduce postharvest loss among smallholder farmers in Kenya and Rwanda. The case study draws on lessons learned from this partnership, as well as from analysis conducted by Partnering for Innovation, notably Success Factors for Commercializing Agricultural Research: Lessons from Feed the Future Partnering for Innovation. The case presents a set of knowledge exchange touchpoints to facilitate collaboration between publicly funded research institutions and private sector businesses in successfully and sustainably scaling innovative agricultural technologies.

Keywords: knowledge exchange; learning; research institutions; private sector; small farmers; agricultural technology; scaling; postharvest losses; Kenya; Rwanda

Background

Publicly-funded research institutions and private sector businesses often supply innovative ideas and solutions to the numerous challenges smallholder farmers in developing countries must overcome on a daily basis. These ideas can evolve into practical solutions that help smallholder farmers plant, grow, harvest, process, and market their products. While publicly funded research institutions and private sector businesses operate according to distinct sets of perspectives, motivations, and objectives, these differences can be complementary and result in transformative outcomes.

The knowledge generated by publicly funded research institutions offers a critical starting point for many product breakthroughs addressing real-world challenges. These breakthroughs can provide an opening for the private sector to transform them into commercially viable and accessible products. Interaction between research institutions and the private sector in this way is frequently seen within the public health domain: researchers conduct studies for promising new treatments and medicines, which incentivize pharmaceutical companies to license, further invest in development, and sell them. Similarly, publicly funded agricultural research often results in scientific advances, such as improved plant varieties, that can transform the livelihoods of millions of smallholder farmers around the world. Once developed, they can be sold to and commercialized by private companies to reach farmers on a large-scale. In this way, research institutions develop the foundational scholarship for new products (many of which are designed to address a societal challenge), and businesses build from this work to create affordable and profitable products. Early collaboration among these actors is a key part of this process in order to achieve greater efficiency, lower cost, and more impact (Partnering for Innovation 2016a).

Within the context of international development, reaching vulnerable consumers at scale with needed products or services is a key objective. Driven by a heightened interest among donor agencies, researchers have adapted their strategies to demonstrate scaling results. Within the agricultural sector, research entities have responded in the following ways (Koerner 2019; Partnering for Innovation 2016a):

- Starting or strengthening technology transfer offices within their institutions.
- Partnering with multinational companies to scale research through supply chain interventions.
- Partnering locally in developing countries with nongovernmental organizations (NGOs) and private sector businesses to deliver research products directly to smallholder farmers.

A growing body of work, evident in paper topics and conference themes,[1] demonstrates a strong interest among researchers in identifying effective approaches for directly reaching smallholder farmers with research-based innovations. Likewise, private sector actors are shifting toward traditionally underserved markets, including rural agricultural settings, as potential growth areas.

Partnering for Innovation's efforts to scale agricultural technologies in emerging markets, since its inception as a program nearly a decade ago, illustrate that knowledge exchange among different actors serves as one of the most effective ways to bridge publicly funded agricultural research and commercial scaling of resulting technologies.

Concept of knowledge exchange

The concept of knowledge exchange used in this paper pertains to the two-way flow of information and expertise among disparate actors engaged in introducing innovative new agricultural products to the commercial market. This approach is illustrated in the case study presented here, which describes the role of knowledge exchange in a multi-year agricultural technology partnership between Feed the Future Partnering for Innovation and Purdue University (Purdue).

Each actor played an essential role in the overall success of the partnership. Purdue possessed an innovative postharvest storage technology, and required a pathway from its laboratory to farmers' fields to launch it. On the other end of the spectrum, private sector distributors and retailers with deep knowledge of local markets identified the strong consumer interest and sales potential such a product offered. Partnering for Innovation provided the bridge to connect the two, recognizing each of these actors were critical for ensuring a new technology reached its intended beneficiaries in a strategic and sustainable way.

In the case study to follow, touchpoints are presented to illustrate specific instances of how the partners' use of knowledge exchange[2] contributed to the successful scaling, production, and marketing of a postharvest storage technology in Rwanda and Kenya. The article concludes with a presentation of key lessons learned for use by international development practitioners seeking to incorporate knowledge exchange into initiatives involving the scaling and commercialization of publicly funded agricultural research.

What is scaling?

The concept of scaling differs between international development and business. In international development, the concept of scaling, at its most basic, involves replicating donor-funded activities to reach more beneficiaries (scaling up) over a larger area (scaling out) (Hartmann 1997; Wigboldus 2016a). Such replication is intended to result in increased and improved benefits in developing countries. In business, on the other hand, the concept of scaling equates more simply with growth, regardless of who benefits or where those benefits are conferred (McLean 2019). The scaling up and out of donor-funded programs in developing countries is often defined as horizontal scaling, or increasing the number of people reached within a specific spatial element (e.g. national or regional levels). Vertical scaling includes activities that enable organizational and political landscapes to replicate development activities (e.g. government policy, rules, norms). Finally, functional scaling entails translating effective interventions across systems (e.g. from the health care sector to the agricultural sector) (Hartmann 2007). The common denominator across these scaling types is creating beneficial social impact.

In practice, local contexts and realities often shape how donor-funded development is scaled. These complexities, therefore, make it difficult to arrive at a common definition[3] for scaling in international development contexts, and an array of methods, pathways, and models have proliferated in its absence. Scholars of international development seek to account for these complexities by expanding the definition of scaling to reflect a systems perspective (Wigboldus 2016a; Wigboldus 2016b). This approach is of particular relevance for agriculture, especially in relation to scaling a technology, given the wide range of interactions that occur across production, marketing, and consumption systems; academic disciplines; and knowledge management and communications.

Other scaling concepts focus on the application of different tools and methods to manage such complexities. In the agricultural sector, inclusive business models drive scale by integrating smallholder farmers and other vulnerable market segments into a firm's supply chain, while innovation platforms[4] bring private and public actors together to develop multiple pathways for scaling a practice or technology across a population. These approaches share the goals of scaling technologies for broad development and profit-making (Wigboldus 2016a; Nelson 2020), and rely on strong and transparent knowledge exchanges to achieve successful outcomes.

Defining scaling is important when navigating the different motivations for achieving it. In the case study presented here, researchers are motivated by the prospect of providing farmers in Kenya and Rwanda with an important postharvest storage solution, and businesses are

incentivized by the commercial viability of that solution. In this context, the concept of scaling is set in relation to negotiating these different motivations on a continuous basis and through the effective use of knowledge exchange to ensure the technology reaches its intended recipients.

Project overview: Purdue Improved Crop Storage (PICS)

Grain production is a cornerstone of food and income security for millions of rural households in developing countries. Despite its importance, 50 to 60 percent of cereal grains are lost to pests and diseases each year due to inadequate storage (Kumar 2017). The impact of postharvest loss at this scale is far-reaching, ultimately reducing the amount of grain available for household consumption and preventing smallholder farmers from storing it to sell at potentially higher prices outside of harvest seasons. Shifting to new storage practices that reduce postharvest loss greatly strengthens farmer livelihoods and food security.

To overcome such grain loss among East African smallholder farmers, Purdue developed PICS (Purdue Improved Crop Storage) bags.[5] The triple-lined plastic bags are a small-scale hermetic grain storage solution. At a cost of approximately $2.50 each, the bags provide farmers with an affordable, reliable, and easily adoptable way to store up to 90 kilograms (kg) of grain on their farms over multiple seasons without the need for pesticides or training. Purdue originally developed the bags for cowpea storage in the 1980s. After additional research showed the bags were able to deliver similar benefits for maize and other grains, the university began to license the bags to West African manufacturers and distributors for sale across the region. Success was fast, with more than 2 million bags sold through 12 licensed local manufacturers and distributors between 2007 and 2013. The success of the PICS bags in West Africa offered strong potential to benefit significant numbers of smallholder farmers in other key grain-producing countries across the continent. Equipped with this proven technology, Purdue sought financial support and commercialization expertise to help scale the bags into East Africa. The team submitted a proposal to Partnering for Innovation in 2013 to introduce PICS bags in Kenya and Rwanda.

Partnering for Innovation, in keeping with its mission to expand commercial access of transformational technologies to smallholder farmers, selected Purdue and two local private sector businesses as partners on a multi-year effort to introduce and scale the PICS bags in Rwanda and Kenya. Since Partnering for Innovation's launch in 2012, the program has served as a bridge between research institutions and the private sector in transitioning innovative agricultural technologies into new markets. The partnership with Purdue is one of the program's

63 partnerships in 24 countries that have directly led to the commercialization of 124 technologies and management practices (Partnering for Innovation 2020).

In Kenya, Purdue introduced PICS bag in partnership with Bell Industries Ltd. (Bell Industries), a local private company, that led local market access and adoption of the technology over the long-term. The partnership aimed to increase access and adoption of 17,500 PICS bags by smallholder grain producers across the country. As of 2016, Bell Industries had sold 835,161 PICS bags (Partnering for Innovation 2014) benefiting 208,804 farmers (Partnering for Innovation 2016b). Similarly, Purdue partnered with EcoPlastics, a local private sector partner in Rwanda, to lead market access and adoption of 15,000 PICS bags by smallholder grain producers. As of 2016, Purdue and EcoPlastics had sold 116,545 PICS bags, benefiting 58,259 smallholder farmers. (Partnering for Innovation 2016b).

Under its partnership with Partnering for Innovation, Purdue lifted its royalty fee to incentivize distributors in Kenya and Rwanda, enabling distributors to test the product's market viability. By the end of the partnership, distributors began paying royalties; Bell Industries and EcoPlastics became self-sufficient in manufacturing, marketing, and selling the PICS bags; and smallholder farmers in both countries benefitted significantly.

Exchanging knowledge: three key touchpoints

Knowledge exchange[6]—described as touchpoints in this article—facilitated interaction among Partnering for Innovation, Purdue, and private sector distributors and retailers in co-creating efforts to scale the PICS bags. Identifying and utilizing the tacit knowledge and motivation of each partner were critical aspects of this process. As detailed below, a set of key touchpoints provided a guiding structure to these efforts.

Touchpoint 1: Co-creation through due diligence

Due diligence provided Partnering for Innovation with an opportunity to co-create a plan with the potential partner, combining assurance that donor compliance requirements are met while working collaboratively to discuss, negotiate, and refine funding details. Importantly, this process included Partnering for Innovation staff visits with potential partners in Rwanda and Kenya to clarify gaps regarding the proposed product/service and business model.

During these interactions, product pricing, intellectual property, manufacturing, distribution, organizational capabilities, and potential timelines for breaking-even on the proposed product

(see the due diligence survey here) were investigated. These criteria were made explicit with all potential partners to ensure commercialization strategy objectives and targets were clear at the outset. Ambiguities were discussed immediately to address any strategy gaps.

In the case of PICS, Purdue researchers used this process to identify potential manufacturing and distribution challenges before local companies were signed as partners. In Kenya, the original distributor lacked sufficient experience in the agricultural sector and an established distribution network, which ultimately impacted the timeframe for introducing and scaling PICS bags. Partnering with this company would have required Purdue to establish additional partners during the course of the partnership at additional cost. As a result, Partnering for Innovation asked Purdue to identify an alternative distributor more suited to help accelerate PICS commercialization in Kenya.

In response, Purdue proposed a new company – Bell Industries, a regional distributor of agricultural products with headquarters in Kenya. The company already managed an extensive distribution network in the country and had the internal capacity (i.e. people, processes, and technologies) to effectively reach smallholder farmers. Bell Industries was also a trusted name in rural areas of Kenya, with marketing capabilities and knowledge of integrating training about the bags with NGOs, farmer-based organizations (FBOs), women's groups, and local business service providers. Alignment with Bell Industries, an established business with a good reputation, enabled Purdue to establish an accurate price point for the PICS bags. This meant that the partners did not need to use valuable time testing distribution and marketing models to determine an appropriate price, and could therefore hit-the-ground-running with a targeted marketing effort at the start the grant. The PICS bags were ultimately sold by Bell Industries to agrodealers for $1.52 per bag and retailed to farmers for $2.34 per bag.

By viewing due diligence as an opportunity, Purdue was able to reassess its initial distribution and marketing plan, and identify Bell Industries as the right distribution partner. Such well-fitting distribution partners are uncommon, making it vital in commercial scaling processes to thoroughly assess the market system first or plan to commit time and resources to build a distribution network. Finally, the due diligence process also enabled Purdue to hire a local manager in Kenya to direct expanding commercial availability of PICS bags from West Africa to Kenya.

Touchpoint 2: Co-creation through technical inputs

To introduce the PICS bag to consumers in Kenya, and in keeping with a Partnering for Innovation social impact goal to improve gender outcomes, Purdue and Bell Industries

conducted a market assessment focused on identifying constraints facing potential female customers. Drawing on market assessment findings regarding women's role in household decision making, Purdue and Bell Industries developed and implemented a marketing campaign that advanced scaling efforts of PICS bags in the country while also reaching women in smallholder communities.

The market assessment also helped the team identify specific tactics that would be most impactful. For example, the marketing campaign was implemented through village demonstrations using farmers' personal grain supply. This was a powerful way to introduce the utility of the PICS bags directly to farmers, and over the one-year partnership, 100 market demonstrations reached 5,674 participants. The team introduced bag opening ceremonies at which PICS service providers filled PICS bags, sealed them, and three months later opened them to the public. The opened bags provided visual proof to potential customers, the majority of whom were illiterate, that grains stored in the bags emerged free of pests and diseases. Additionally, Purdue and Bell Industries targeted commercial distribution and retail networks to equip them with materials and messages for potential end-consumers. This involved visiting shops to train employees, distributing educational materials on how to use the bags, and advising on smart display placement of the bags. All of these elements raised the profile of the PICS bags in Kenya.

Touchpoint 3: Ongoing co-creation through frequent dialogue

Structured, regular dialogue among partners served as a major knowledge exchange touchpoint during the partnership. Monthly partner management calls, in particular, provided established times for all partners to come together in a transparent way to discuss progress, setbacks, and successes. These calls set the stage, and continually reinforced, a collaborative, team-focused culture among team members as they co-created scaling strategies, processes, and implementation. The management calls provided three concrete ways in which knowledge exchange generated results: 1) troubleshooting issues; 2) forging new collaborations and resources; and 3) forecasting or generating creative solutions to driving costs down to achieve maximum commercial results.

Troubleshooting

A clear example of how knowledge exchange engendered a forward-focused, team-centered approach to problem solving occurred early on in commercializing PICS bags in Kenya. Bell Industries encountered a cash flow problem because its manufacturer was unable to extend credit as originally anticipated. The company invested its own cash reserves to purchase and distribute the bags across its agrodealer network, a risk compounded by the agrodealers refusal to purchase

the bags outright as they preferred to push the risk to Bell Industries and pay for the bags once they were successfully sold to smallholder farmers. This further restricted Bell Industries' cash flow. Partnering for Innovation, anticipating such business setbacks in the initial design of its grant model, was able to work with the partners to find a solution to ease the cash flow issues as PICS sales increased. As a result, Purdue and Bell Industries began to explore new options for manufacturing the product, with Bell Industries opting to make significant investments in its manufacturing capacity and began purchasing the PICS bags directly.

The ongoing management calls allowed early identification of the problem so that all partners could pivot quickly, and in tandem. Such calls also prepared Partnering for Innovation team members for troubleshooting issues during their yearly site visits. These visits allowed partners to discuss issues more in-depth, particularly as the partnership entered the commercialization phase of the PICS bags. For example, in working with retailers during a site visit, Partnering for Innovation managers were able to talk to shop keepers to change bag placement to more favorable shelving locations.

Forging new partnerships and resources

The management calls provided an opportunity to tap into each partners' networks to help advance the partnership. Bell Industries was able to leverage its agrodealer network to jump-start distribution, while Purdue drew on its West African network to support its new efforts in East Africa. Partnering for Innovation was able to leverage its extensive field presence in Kenya to expand the reach of the partnership, such as by connecting the PICS team in Kenya with the USAID-funded Kenya Agricultural Value Chain Enterprises (KAVES) project.

Implemented by Fintrac Inc., KAVES had a significant presence across Kenya's maize value chain and joined with Bell Industries to test the use of PICS bags under various field conditions and directly with farmers. KAVES purchased 2,500 bags from Bell Industries and used them for demonstrations in 22 target counties, dramatically expanding the marketing footprint for the bags. KAVES also organized PICS bag trials in collaboration with even more partners, such as local agribusinesses, the Ministry of Agriculture, farmer groups, small-scale traders, and local NGOs. PICS bags became increasingly known among farmers and were tested for cost effectiveness, efficiency, and impact at the household level.

The extensive testing provided evidence that PICS bags prevented insect damage at a 98 percent success rate. These findings drove KAVES to partner more closely with Bell Industries on promotional activities such as field days, radio advertisements, and market demonstrations to further raise awareness of the technology. The regular partner management calls played a major

role in connecting the two entities, and is cited as a major reason for PICS scaling success in Kenya (Foy and Martin Wafula 2016).

Forecasting

Monthly management calls prioritized next steps to help partners identify and manage future needs. This aspect of the calls was of particular value for Purdue and Bell Industries in developing a sustainable commercial scaling plan given the significant growth resulting from alignment with the KAVES project. The calls also provided the necessary space for partners to determine that the existing distribution model for PICS bags needed to be transitioned to a more cost-effective one that would be capable of distributing the bags to private sector agrodealers throughout the country. As a result, new ways to piggyback off existing donor-funded programs and commercial distribution models were explored as a final step in the year-long partnership.

Conclusion

Knowledge exchange plays a critical role in scaling publicly funded agriculture research. When embedded as a core component of the process, knowledge exchange can unlock solutions that are compatible with the distinct motivations of different actors – researchers, private sector actors, and donors –while also advancing the overall objectives of the partnership. By establishing pre-determined touchpoints, actors are better positioned to maximize co-creation opportunities for troubleshooting, leveraging unique knowledge and resources, and forecasting potential future challenges and opportunities.

The success of scaling PICS into East Africa was built on its proven performance in West Africa, and augmented through purposeful knowledge exchange between and among partners in Rwanda and Kenya. It illustrates larger lessons studied from across similar partnerships developed under Partnering for Innovation. Practitioners can draw from these lessons to replicate similar success for scaling technologies in developing countries. Specifically, integrating at least three knowledge exchange touchpoints – initial due diligence, technical inputs, and regular, ongoing interactions – offer a sound structure to support the successful and sustainable scaling of innovative agricultural technologies.

Limitations

This case study represents the experience of Partnering for Innovation. The goal is to support other practitioners to embed knowledge exchange activities into efforts that scale publicly funded agricultural technologies through commercial means. From the experience of Partnering for

Innovation, such exchange is an integral part of successfully scaling publicly funded research, as well as in any development initiative. As discussed above, there are also numerous definitions, motivations, drivers, and pathways for scaling that can be drawn on for customizing strategies to unique contexts and pathways; there is no single solution or recipe for success. It is important to note that not all research is suitable for commercialization, and the public sector can, and often does, play an important role in supporting basic research that may be far removed from commercial application.

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[1] See, for example, Piñeiro, M (2007); Sartas, M. (2019); Koerner, J. (2018).
[2] See all Partnering for Innovation tools in the program's Practitioner Guide here: https://www.partneringforinnovation.org/practitionersguide.
[3] For a full discussion about the definition of scaling in international development, see Wigboldus (2014) and Frake (2017).
[4] Innovation platforms are designed to bring multi-stakeholder groups together for achieving development impacts at scale, see Totino, E. (2020).
[5] The case background information is taken from Partnering for Innovation grant documents, articles written during the partnership, and past interviews.
[6] See all Partnering for Innovation tools in the program's Practitioner Guide here: https://www.partneringforinnovation.org/practitionersguide.

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REFLECTIONS

Disentangling challenges in mainstreaming smallholder farmers' perspectives into knowledge co-creation processes: evidence from Benin

Mawuna D. Houessou and Frejus S. Thoto

Achieving impact at scale in the agricultural sector demands the contribution of all stakeholders for transformational changes. However, although smallholders form most agri-food value chains, actors, in developing countries, their voices and idiosyncrasies are little consulted and accounted for in policymaking. Yet, co-creation knowledge processes efforts to improve such situations are ongoing but face operational challenges, usually context-specific, that the literature fails to point out. Our reflection addresses the knowledge gap and discusses how to effectively engage smallholders in critical discussions regarding the sustainable transformation of agriculture. We showed that when discussing with smallholders about their livelihoods and economic activities, they often demonstrate poverty and misery to entice policy interventions; *falsifying responses, if necessary, is part of the strategy*. We thought that the reason justifying such a situation might be because many knowledge processes consider smallholders as passive information providers; therefore, we made a call to researchers to ensure smallholders understand the research purpose and contribution to policymaking. However, there is still a risk of information falsification in the other way around, bringing to the attention that there is no easy solution. We, therefore, suggest that researchers be cognizant of the risk and deal with it in two possible ways: using indirect objective questions in place of direct subjective questions and triangulating information.

Keywords: Knowledge integration; knowledge co-creation; knowledge management; agribusiness; smallholders; farmers; private sector; evidence-informed policymaking; sustainable development goals; agricultural development; Benin

It is now evident in the literature that smallholder farmers, herein referred to as smallholders are real entrepreneurs. We have empirical proofs from research among inland fishers (Sonneveld et al, 2019) and urban gardeners (Houessou et al, 2019) that smallholder farmers have good

managerial capacities to succeed in agribusiness: they take risks by launching new ventures, they can hire and pay temporary and permanent workers, manage the purchase of inputs and sale of products, make profits from their activities, and develop resilient attitudes in the face of challenges and shocks. As such, they can fully be considered as microentrepreneurs and, therefore, actors of the *for-profit* private sector.

Mainstreaming the perspectives of smallholders into agricultural policies and programs have become a must for sustainable development. In developing countries where smallholders form most agri-food value chain actors, it is critical to account for their idiosyncrasies to make them a significant player in achieving the Sustainable Development Goals (SDGs), especially Goal 2: Zero Hunger. However, the voice of smallholders is still marginalized and even when efforts are made to include and work with them, integrating their perspectives is difficult. While such difficulties are, for the most, context-specific, operational challenges for co-creating knowledge with smallholders to inform agricultural policies and programs are under-documented. Thus, there is little evidence on how to effectively engage smallholders in critical discussions regarding the sustainable transformation of agriculture. This reflection aims to address the knowledge gap by reflecting on the operational challenges faced when engaging smallholders in co-creating knowledge to inform policy interventions.

Our contribution learnt from extensive collaboration with urban gardeners to co-create knowledge that would help formulate evidence-informed solutions on how to support the development of urban agriculture in Benin. In our study, we adopted a transdisciplinary approach to urban agriculture in Benin (Houessou et al, 2019) and actively involved the perspective of urban gardeners in formulating policy recommendations. Therefore, we held several discussions (individual interviews and focus groups) on relevant options that fitted in their needs and constraints. A focus group discussion was organized with twenty men and women urban gardeners and two experts from the Ministry of Agriculture, Benin, to discuss findings of a study on the benefits of gardening, including profitability and organization. A first finding shared to gardeners was that loans are insufficient, and related conditions are unsuitable for urban gardeners. They confirmed that loans granted to them do not cover their financing needs and conditions attached to the loans do not fit the gardening activities (no grace period, no possibility of deferment, high-interest rates, and short repayment period). They also added that the reluctance of many financial institutions to provide loans to gardeners is a constraint for financing their activities. Though the contribution of smallholders was informative on this finding, feedback on another finding was not as positive as the former one. The research team also shared that urban gardening is profitable and can help gardeners cover their basic needs and improve food security. Reactions, after sharing that result, were in a first attempt negative in the

sense that they disagreed with the finding. The reason given to justify such reactions was that they do not make enough money from gardening and cannot consider themselves as well-off people who do not need support. Thus, in their *perception*, indicating that urban gardening is a profitable activity, is a bottleneck for obtaining support from the government or other actors.

As researchers, we were aware of such reactions and thereby *possible falsification* from smallholders and explained anew the purpose of our discussions which was to understand the benefits of urban gardening to making informed recommendations to policymakers on how best they can support urban agriculture. As we mentioned that the research findings could lead to support from policymakers, the group of gardeners changed their initial feedback and confirmed the profitability of their business. They highlighted that urban gardening allows them to cover their basic needs, and then corroborated their response with additional examples. A strong argument provided to support the finding was that they would have already abandoned the gardening if it were not profitable. They also added that some gardeners had quit their side jobs to allocate more time to gardening, an excellent proof of the profitability of the activity.

The above-described story shows that smallholders often tend to understate the profitability of their activities to portray a necessity condition hoping that it will trigger more support towards them. Not only, this indigenous perception is *wrong*, but it may also lead smallholders to suggest *inadequate* recommendations that would have adverse effects on their activities in the long term. There is evidence that convincing decision-makers to support urban agriculture depends on how they are convinced about the profitability of the sub-sector. For example, we recently conducted a review on factors that are constraining the expansion of urban agriculture and found that the benefits of investing in urban agriculture are still unperceived by the government; corroborated by the fact that the government of Benin makes huge investments in cotton and cashew vale chains because they are convinced about the potential of these products on the livelihoods of farmers and the economy. Therefore, increasing political priority is likely if gardeners could demonstrate the positive impact of urban gardening on their lives; *not the contrary as they intended to do*.

As we reflect on the reasons for such behavior from smallholders, the main explaining factor is how researchers involve smallholders in processes of knowledge co-creation. In many processes, smallholders play the role of *information providers* as respondents to questionnaires or "passive" participants in interviews. They know little about the research objectives, its approaches, and the analytical framework. It is largely argued and recommended that smallholders are "fully integrated" into research processes, but in practice, this is not easy. In the story described above, if the urban gardeners had a deep understanding of the research objectives and how the research

interpreted findings, they might be more comfortable about discussing the profitability of their businesses. Therefore, we make a call to researchers working to involve smallholders in knowledge co-creation to ensure smallholders understand what information is essential and how it will be interpreted in terms of policy recommendations.

However, there is a *risk*. By ensuring that smallholders fully understand the research objective and contribution to policymaking, there is a risk that they also provide *falsified* information that would trigger support from policymakers. Thus, be aware and deal with that risk is the solution, and researchers should be cognizant that there is no easy way. Nonetheless, we foresee two options to address the risk. First, researchers may make use of indirect objective questions in place of direct subjective questions. For example, during discussions with smallholders, questions such as "is your business or activity profitable?" could be replaced by more indirect questions about associated benefits such as 'details of what is purchased or accomplished with generated income?'. Then, gathering accomplishments during the discussions would easily bring in what the conclusion is, regarding the business profitability. Second, there is information triangulation. Triangulation is a verification technique that uses more than one method to collect data on the same topic and assure the validity of the research.

To sum up, this reflection piece has shown that when discussing with smallholders about their livelihoods and economic activities, they often tend to demonstrate poverty and misery to entice policy interventions, and they may falsify information if needed. We, therefore, advocate that researchers consider the risk of falsification and continue to fully mainstream smallholders in knowledge co-creating processes; of course, making them aware of the research purpose and contribution to policymaking is a must to make informed recommendations for impact at scale.

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COMMUNITY NOTE

Knowledge management and the coronavirus pandemic: an online discussion

Chris Zielinski

Between 30 March and mid-June 2020, the Knowledge Management for Development (KM4Dev) listserv was host to an online discussion on knowledge management (KM) and coronavirus, moderated by Chris Zielinski. Over 30 participants submitted some 80 contributions to the discussion. A Knowledge Café was held on 14 May 2020 in which the topic was further discussed (https://vimeo.com/420811042). The present paper seeks to organize this rich material thematically and summarize the discussions. KM4Dev wiki contains the complete set of emails received (wiki.km4dev.org/Talk:KM_and_Coronavirus). The principal contributors to the discussion are named here, and the full list of discussants is given in the acknowledgements.

Keywords: online discussions; knowledge management; coronavirus; infodemics; pandemics; information; misinformation; KM4Dev

Introduction

Between 30 March and mid-May 2020, the Knowledge Management for Development (KM4Dev) listserv was host to an online discussion on knowledge management (KM) and the coronavirus, moderated by Chris Zielinski. Over 30 participants submitted some 80 contributions to the discussion. The present paper summarizes this discussion thematically.

The infodemic at the heart of the pandemic

The COVID-19 pandemic has been accompanied by what WHO's Director-General has termed an 'infodemic' – an over-abundance of information (some accurate and some not) – that makes it hard for people to find trustworthy sources and reliable guidance when they need it (Adhanom Ghebreyesus, 2020). The focus on information and misinformation is striking, as this has always been a relatively ignored and unfunded component of the international development effort. Some of the problems in this area – notably the scarcity of indicators, the

relative lack of research in methods for disseminating good information and countering bad information – are very much current concerns with COVID-19.

Impact of COVID-19 on sectors

Clearly, the pandemic has put enormous strains on the public health systems around the world, and it has raised questions about its potential impact on food supply, food demand as well as on the global economy as a whole. The distinctively different local contexts mean that each country in the world has since been challenged to come up with both national and international responses to the knowledge management of the crisis. "National", since each country had its own institutionalized reporting system and knowledge management infrastructure, and its own duty, whether legal or purely ethical, to keep its citizens informed. And "international", in response to a globalized knowledge management system based on pre-existing accords in such bodies as the World Health Assembly.

The cross-linking of international centres of knowledge excellence appears to be a new form of trans-sectoral knowledge management. Atsu Sename noted that, in Africa, COVID-19 impacts the start-up economy. Faced with this crisis situation, he asked what strategies could knowledge management (KM) offer in supporting small start-ups in Africa? Larry Hiner felt that the enforced slow down of work provided an opportunity to collect success case studies, which, with proper curation, could help the start-ups fare better when the pandemic passes. Nancy White stated that some sectors are now running at a frantic pace while others have been obliged to pause. For example, front line workers in health care, education, transportation are working long hours, often at high personal risk. In some countries, small businesses have not received the same kind of government support as large corporates. Unemployed staff don't have any social safety net or health benefits when pay stops.

John Hoven stressed that KM can help with strategies that support exploratory search and connecting across disciplines. People (notably expert professionals) tend to rely on trusted sources, but this strategy can insulate them from new knowledge. While modern corporations actively search for people who "look outside the box", this is rarely seen in government and social organizations.

How can new knowledge be managed?

John Hoven offered a typology of the knowledge landscape presented by COVID-19. This included: 1) rapidly emerging information, 2) distinctively different local contexts, 3) fast real-time iteration between data collection, storage, distribution, action, impact, and analysis. He termed this Rapid Knowledge Management (RKM), or New Knowledge Management

(NKM – in the sense of "the management of new knowledge", rather than "a new kind of knowledge management"). There are already emerging models for this (Boyes, 2019). He offered some principles for KM in the face of imminent disaster: 1) the need to take bold action (in COVID, focusing on dense urban areas, nursing homes for the elderly, meatpacking plants, etc.); 2) the urgency to learn, even when we are ignorant of the exact nature of the threat; and 3) the need to act flexibly as we learn (e.g., in rapid prototyping, learning by doing, qualitative theory building, etc.).

John Hoven felt that the rapid iteration between data collection and analysis (e.g., rapid prototyping, qualitative theory building) generated new knowledge. While much of the "knowledge" gathered during this exploratory process has little or no lasting value, it nevertheless helps to discover knowledge that does have lasting value. New Knowledge Management covers more than simply the storage and sharing of recently discovered knowledge. It includes managing transitory knowledge during the exploratory process, and indeed managing the exploratory process.

A basic question was, why is KM for COVID-19 different from the application of KM in other fields? An answer was that it was not necessarily different – it was a case of trying to understand how best to adapt KM concepts, methods and tools to support COVID-19 management. Do we just need to do KM better and faster, adapting to new situations what we already know how to do? Do we need to learn how to make a stronger case for KM and learning in a crisis? Do we need to demonstrate the value of KM approaches and tools in helping communities, governments and organizations to learn and adapt rapidly. Do we need to get better at coming up with solutions and acting very quickly?

COVID-19 was pushing us to learn and act at a pace much faster than academic research, and often to do so while actions and outcomes were still interacting. While organizations such as institutions may not have the capacity to learn, the individuals within those institutions can learn, although they may struggle to absorb and institutionalize their lessons. Peter J. Bury suggested that managing knowledge rapidly risks leading to the management of 'knowledge' that has little or no lasting value, and noted that there was a world-wide trend of people in power using the pandemic situation and related fears to grab even more power.

Dealing with multiple narratives

Bruce Boyes noted that the uncertainty and ambiguity caused by the new and unexpected leads to the need to consider multiple narratives, each of them potentially valid. Three of these reactions to the virus outbreak were characterised by Nick Chater in *Nature* as 'a storm in a teacup', 'a house on fire', and 'holding back the tide' (Chater, 2020). There was a massive effort in different countries to manage knowledge at the beginning of this epidemic – mainly to suppress or dismiss it as inconsequential ('storm in a teacup'). Then, as the scale of the

problem grew uncontrollably, control measures were imposed – either radical ('house on fire') or mitigating ('holding back the tide'). The ability to manage knowledge about the pandemic also became uncontrollable. The alternative narratives highlights the importance of 'multiple knowledges and multi-stakeholder processes in the solution of 'wicked problems' (Cummings et al, 2019).

New knowledge, wisdom and trust

Managing the acquisition of new knowledge may be more important in KM than codifying and storing. This crisis poses a challenge for knowledge brokers. COVID-19 is leading to the production of massive amounts of knowledge – some of which is valuable and helpful, much of which is repetitive, speculative and perhaps even adding to the confusion. Knowledge brokers seek to bring together different perspectives and sectors; to synthesise complex and voluminous knowledge into something that is accessible and usable; and to create some order and sense. What is important is to produce a synthesis: not just culling and selecting, but identifying trends and generating new insights in a responsive and timely manner. Currently, the big challenge for knowledge management is not so much the knowledge, but (a) the management and (b) the demand for knowledge. We need to think how to strengthen processes of collective impact, positive (centralised and decentralised) leadership, joint planning, joint capacities, networking, transparent communication, systems of incentives and mutual accountability.

Sebastian Hoffmann pointed out that the wealth of data and visualization do not necessarily help in complex decision making: it can have the opposite effect, even though the knowledge provided is essentially important. While we may be good at managing declarative knowledge (know-what) and procedural knowledge (know-how), this was not always the case with reasoning knowledge (know-why), supported by new data analytics technologies. Ideally, reasoning knowledge should help to create decisions supporting wisdom on top of knowledge. During this crisis, figures have been correlated and interpreted by violating basic rules in statistics and science. Reasoning knowledge has not generated adequate wisdom. He suggested that 'human wisdom' is a separate knowledge management issue in a pandemic like coronavirus because of the complexity of the multidisciplinary subject and the tremendous scope of consequences for society. Stephen Bounds felt this wasn't a problem of 'wisdom' (which he defined as 'the ability to correctly spot weak patterns from past experience'), but rather the existence or absence of decision-making frameworks at an organizational and supra-organizational level.

There was also a problem of a lack of trust in institutions. In this context, Yacine Khelladi reported on cases in two Caribbean countries where, as a result of very low trust in the ability of local authorities to manage the crisis, and poorly prepared and inefficient health systems, violence broke out against suspected COVID-19 carriers.

Ethical use of data

In discussing contact-tracing and other apps that had implications for privacy, Denise Senmartin asked how to deal with privacy and personal data when developing technical solutions for helping people and governments deal with the pandemic? Veronique Sikora questioned the purpose of designing such an app. She stressed the need to care for one another and to build community. There are countries where the government is working for the people and using data in a responsible way.

An app could help but it could also be a way of tracking people, and it could lead to scaremongering. Some felt that privacy is at risk: 'No-one, no government, will be able to warrant that collected IP addresses of mobile phones will be completely erased once the pandemic is over. And so this very private information could be misused in the future' (Peter J. Bury).

Proportionality and optimal timing

Charles Dhewa raised a concern about the proportionality and optimal timing of the drastic public health responses to COVID-19 being implemented by countries far away from the epicentres. It is hard to act radically when the threat appears to be far away. There is a Shona idiom which says *Haupisi imba nokuti yapinda nyoka* meaning 'You don't burn your house merely because a snake has entered the house.' In other words, your reaction should be in proportion to the challenge. Afrocentric knowledge brokering combining traditional wisdom with subject matter expertise is one skill lacking in our policy arena. 'Burning down the house on suspicion that there might be a snake inside. And as the house goes up in smoke you see the snake hiding in the fowl run.' Michael Hill put this Shona wisdom into a contemporary Americana perspective: 'Because New York City is a mess, you want us to shut down Montana and Wyoming, where there has been almost no deaths, few cases, and the hospitals are almost empty?'

Other issues

Euphresia Luseka, a water, sanitiation and hygiene (WASH) specialist, expressed the view that, in webinars on the COVID-19 pandemic whose titles explicitly reference Africa, it was generally true that all the conveners and presenters were from and in Europe. There are often no women on the panels. As KM practitioners are often the ones who prepare such webinars, she urged the KM4Dev community to ensure that webinar panellists are balanced in terms of region, gender and age (youth) representation.

Chris Zielinski posted a short list of knowledge management issues in coronavirus which was subsequently expanded by other contributors. The consolidated list is given in Annex 1. Wycliffe Omanya noted the basic KM problems of deciding what to do first, in the short term and medium term? How do you decide what needs to be postponed? How do you select what goes virtual? How do we learn and adapt? He provided an Activity Priority Model for COVID-19 (see Annex 2).

What we are learning from our digital solitudes

Francois Stepman provided an eloquent overview of the digital solitude in which many of us found or still find ourselves, which is given below, in full:

> We can congratulate ourselves on the fact that the overabundant connectivity of our solitudes virtually maintains, during this period of abstention, the vital links that must continue between us. In reality, part of us is surprisingly prepared for this sudden confinement.
>
> Each of us receives and emits bursts of texts and videos intended to raise a united front of virtual solidarity. Uninterrupted transmission of small thoughts, funny stories, spiritual drawings, expressions of friendship. Endless spiral of shared 'emoji' emotions. In this paradoxical 'shared isolation' of 'rediscovered proximity' how not to feel overwhelmed by the communication in loops, saturating the waves, and whose virality undoubtedly intends to compete with that of the real virus. We order in two clicks, we are answered within 24 hours. Food, books, beauty products ... Everything we want is delivered to our doors by masked servants, individuals without names or faces, who have retained the right to move, since they provide our service.
>
> Our new virtual world has suddenly taken a scale - whose impact we have not yet measured. This period of torrential communication, compulsive shopping, voracious idleness, naturally provides a gold mine for profiling algorithms. This was already the case before the epidemic, you may say. Yes, but we were not forced by necessity to expose all of our behaviour and our exchanges online. We were aware of the convenience of electronic communication and e-commerce. We used to see in the power of our electrical equipment, a technological victory over space, over distance. But now, we face a forced and unwanted removal. We had not yet estimated the value of this victory in terms of safety. The development and rolling out of corona virus apps bring us closer and faster to what Harari calls 'the world of data-ism'. However, after this exceptional period, virtual links, which will have temporarily saved our human solidarity, should not dominate the future.

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About the author

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Some ideas from KM4dev

Participants offered a range of ideas on KM and coronavirus:

1. Identify and share best practices and document what is not working well and why, so that we can be ready to improve and support in the future;
2. Identify how KM can better serve organisations, staff and communities. Specifically, how to support staff to ensure they: 1) don´t feel isolated, 2) get the information they need for their work; 3) know whom to reach for specific information. (Rocio Sanz)
3. Virtual cafés (informal spaces where those who feel isolated can engage with others in "virtual cafes". Have virtual sessions where the team checks in for 10 minutes, while holding up coffee cups, etc to the camera. (Rocio Sanz and Mike Hill)
4. Ensure there is a place where all critical information can be stored and accessed. (Rocio Sanz). To develop, or contribute to an existing, curated wiki that provides overview, access and possibility to use reliable coronavirus related information and knowledge. This could be done in close cooperation with other like-minded communities. (Peter J. Bury). Pre-COVID-19 case studies may not be of use: 'Curating a past that may no longer exist isn't devoid of lessons, but I'd be cautious about relying on them in the new future in front of us.' (Nancy White)
5. To build up a global network of partners who commit to providing a bridge between the digital and non-digital worlds for the sharing and collection of information and knowledge locally and internationally. (Peter J. Bury)
6. A blog to address misinformation about COVID-19 (Suzanne Kiwanuka).
7. A brief about how epidemics or in this case pandemics behave and what influences the behaviour of an epidemic curve (Suzanne Kiwanuka).
8. COVID-19 communication tools and methodologies could be made user friendly for the disabled, including the increased provision of a sign language interpreter and written communication tools in braille (Euphresia Luseka).
9. In general, the 'non-privileged' need to be invited to speak or be heard at relevant webinars and other online events, while recognizing that relevant global knowledge on development is not only produced in industrialised countries (Jim Delaney).

Annex 1: A KM preparedness strategy for knowledge management for epidemics/pandemics

Chris Zielinski

1. KNOWLEDGE MANAGEMENT OF DATA

1.1. As soon as a threat of a national epidemic or global pandemic is evident, a data management strategy should immediately be developed and publicly announced
1.2. All data relating to the emergency should be explicitly defined – what data are and are not being collected.
1.3. Data reporting should be in the hands of independent national or international bodies not subject to political control.

2. KNOWLEDGE MANAGEMENT OF COMMUNICATION

2.1. A single authoritative source for all information regarding the threat should be established and regularly maintained. This source should provide or relay:
  2.1.1. The data described in section 1
  2.1.2. Impartial guidance on healthy behaviour to be adopted by citizens
  2.1.3. Guidance on protective measures for all parties (citizens old and young, health carers in hospitals and private institutions, police and others employed in specific public functions, public-facing commerce, businesses, sport, public gatherings, etc.)
  2.1.4. Guidance on medicines and other pharmaceuticals and their conditions of use
  2.1.5. A constantly updated corrective communication effort on mis-/disinformation/fake news and rumours
  2.1.6. Legal recourse against dangerous falsehood based on laws against public incitement to violence, hate speech, Holocaust denial, etc. Such laws should not prevent free speech, or the uncovering of malfeasance, or any of the other work in defence of citizen's rights carried out by the Third Estate.

3. GOVERNANCE OF KNOWLEDGE

3.1. National Chief Science/Medical Officers should be appointed by independent and authoritative scientific/medical bodies and should not in any way be dependent – financially (whether personally or institutionally), or for their employment – on the will of political leaders
3.2. Appointment of a single crisis coordinator

4. KNOWLEDGE MANAGEMENT SYSTEMS

4.1. Establish a KM pandemic emergency strategy, including:
  4.1.1. A listing of all available information sources and mechanisms
  4.1.2. A strategy for connecting across disciplines
  4.1.3. A purposeful search for "unknown unknowns" (rapidly emerging information, unexpected changes in knowledge, social behaviour, testing, and remedies)
  4.1.4. Dynamic databases for rapidly evolving data

4.1.5. GIS for nongeographic data

4.2. Equipment:

4.2.1. Maintain an accurate stock-taking of the amount and location of all equipment required to combat a national epidemic (including personal protection equipment for the general public and for health carers, medical equipment)

4.2.2. Maintain an up to date list of manufacturers of such equipment, including their potential capacities.

4.3. Scheduling:

4.3.1. Establish a clear timetable: what should be done by whom, and by when

4.4. Research:

4.4.1. Into personal protective equipment

4.4.2. Into needed skills

4.4.3. Into economics: effects on citizens, employers, economy at large. How much will it cost?

Annex 2: An activity priority model for COVID-19

Wycliffe Omanya