The socio-political dimensions of agricultural technology promotion in Ethiopia

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The socio-political dimensions of agricultural technology promotion in Ethiopia

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List of abbreviations

ANT	Actor Network Theory
AGP	Agricultural Growth Programme
ADLI	Agriculture Development-Led Industrialisation
AISE	Agricultural Input Supply Enterprise
BMGF	Bill and Melinda Gates Foundation
CA	Conservation Agriculture
CAADP	Comprehensive Africa Agriculture Development Programme
CASCAPE	Capacity Building for Scaling up of Evidence-Based Best Practices in Agriculture in Ethiopia
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Centre
CRP	Crop Research Programme
CSISA-BD	Cereal Systems Initiative for South Asia in Bangladesh
DA	Development Agent
DAP	Diammonium phosphate
DG	Development Group
EPRDF	Ethiopian People's Revolutionary Democratic Front
EIAR	Ethiopian Institute for Agricultural Research
EU	European Union
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
FTC	Farmer Training Centre
GDP	Growth Domestic Product
GTP	Growth and Transformation Plan

IAR	Institute for Agricultural Research
IFAD	International Fund for Agricultural Development
KDC	*Kebele* Development Committee
KPT	*Kebele* Planning Team
MoA	Ministry of Agriculture
SDGs	Sustainable Development Goals
MF	Model Farmer
MLP	Multi-level Perspective
NGO	Non-governmental Organisation
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PADETES	Participatory Demonstration and Training Extension System
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
POINT	POwer-IN-Transition
PSNP	Productive Safety Net Programme
RRI	Responsible Research and Innovation
SNNPR	Southern Nations, Nationalities and Peoples Region
SPSS	Statistical Package for the Social Sciences
SPRS	Sustainable Poverty Reduction Strategy
TPLF	Tigray People' s Liberation Front
TLU	Tropical Livestock Units
TVET	Technical and Vocational Education Training
UK	United Kingdom
USA	United States of America

USAID	United States Agency for International Agricultural Development
USD	United States Dollars
WCDI	Wageningen Centre for Development Innovation
LMIC	Low and Middle Income Countries

Table of Contents

List of figures

List of tables

Summary

Introduction

The Dutch funded CASCAPE programme (Capacity Building for Scaling-up Best Practices in Agricultural Production in Ethiopia) aims to contribute to increases in agricultural productivity in Ethiopia through promoting improved agricultural technologies and building the capacities of stakeholders who are involved in this process. The work reported in this thesis is meant to reflect in a structured and interdisciplinary manner on this programme and in particular on reasons for farmer selection, dynamics around accessing of inputs and markets, and the role of networks and opinion leaders in agricultural technology promotion.

The central research questions of this thesis are: How do socio-political factors shape the interactions between key actors involved in the process of agricultural technology promotion in Ethiopia and how does this result in inclusion/exclusion? In three case studies I zoom in on three process dimensions of agricultural technology promotion: on-farm trials, the dynamics around accessing and opinion leadership.

Main findings

Chapter 2 is a structured literature review. I found two bodies of literature which emphasise two different but complementary sides of the agricultural extension system in Ethiopia. The first body, called ‘agricultural extension literature’, emphasises the investments in and achievements of the agricultural extension service and points to the impressive progress in the past decades in terms of number of extension agents (DAs) employed and the significant role they played in promoting fertiliser and high yielding varieties. Challenges facing the Ethiopian agricultural extension service are framed in a-political terms like ‘limited resources, infrastructure and capacities’.

On the other hand, the ‘political extension literature’ emphasises the practice of *encadrement* whereby state control over citizens is secured and extended at the lowest level possible through administrative restructuring at *Kebele* level. This is effectuated among others through the establishment of new modalities for extension delivery such as model farmers and development groups. The politicised nature of the work of DAs, model farmers and development groups are considered by this body of literature as a historical continuation of the exploitative power relations between dominators and dominated from past times. Part of this reciprocal relationship is that loyal farmers are often rewarded with new social, political or economic opportunities, causing a flow of upward social mobility among the rural population. On the other hand, farmers who are not able or willing to join government programmes are portrayed as disloyal dissenters. This discourse reduces the space for public dissent.

In chapter 3 I zoomed in on on-farm trials, which are considered in the AR4D community as more appropriate than on-station trials because farmers’ fields are assumed to be more representative for the reality of smallholders’ lives. In this chapter I analysed this premise by looking at the role of on-farm trials in agricultural technology promotion as employed in the CASCAPE programme. The dual role of on-farm experiments to provide evidence while also persuading different audiences that the technology in question ‘works’, exposes an inherent tension of on-farm experiments. Pushed by the donor community to demonstrate impact at scale within a project period, agronomist and their partners tend to select areas they already know and farmers that are wealthier and more receptive to new technologies as trial hosts. Such selection biases risk compromising the external validity of on-farm trials, and hence, their scalability. To understand scalability it is important to assess the drivers of technology adoption. On-farm trials are in many circumstances ill-suited to understand these drivers, implying a need for complementary approaches.

Dynamics of access to agricultural technologies are often placed outside the AR4D research frame. In contrast, I took the context in which agricultural technologies are promoted as the point of departure for my analysis in chapter 4 in a qualitative case study on the introduction of malt barley in two highland communities in Southern Ethiopia. The findings suggest that mostly invisible mechanisms (such as clan-based loyalty, reciprocity and vertical accountability) are of critical importance in governing access to the malt barley technology. Certain categories of farmers, including female farmers, farmers of certain clans, and farmers with limited financial and social capital, were not able or willing to invest in reciprocal relations with local authorities. Consequently they were portrayed as 'lazy' or 'not serious' by the rest of the community and authorities and excluded from access to extension services, cooperative membership and other agricultural support. Ignoring such dynamics in the malt barley interventions resulted in an (unintended) scaling effect in terms of perpetuating the social and economic gap between a local elite (often model farmers) and a large group of smallholders.

In the last case study (chapter 5) I analysed the role of opinion leadership in the diffusion of the malt barley technology (in the same area as chapter 4). Agricultural extension services in Ethiopia identify opinion leaders based on pre-set criteria such as wealth, social status and education level. In this paper I explored the effectiveness of this top-down approach by analysing the role of two types of opinion leaders: model farmers (appointed by the government) and nodal farmers (emerging from within the community). I combined quantitative network analysis with qualitative data analysis. The findings show that model farmers are not the most effective entry-point for knowledge dissemination. Nodal farmers on the other hand, shared their knowledge about malt barley with many people and played a gate keeper role in knowledge dissemination. While model farmers were wealthier and better connected to the local authorities, nodal farmers were socio-economically similar to their fellow farmers. Nodal farmers often occupied informal positions in the community, such as being a religious leader or trader. An important conclusion of the findings in this chapter is that knowledge is an important condition for the widespread adoption of the malt barley technology, but it is not enough, particularly when access to external inputs is limited. Other conditions need to be in place too, such as access to inputs and markets, and cooperative membership. These conditions are shaped by socio-political factors such as political connections and social networks.

Answering the research questions

A synthesis of the findings from the various chapters results in the formulation of the answers of this thesis. A historically grown relationship of mutual dependence between local authorities and rural citizens influences the process as well as the outcomes of agricultural technology promotion, in terms of who benefits and who is excluded. One of the effects is the (re)production of a rural elite of successful farmers - model farmers – who, in return for their loyalty to local authorities, receive ample agricultural support, as well as economic and political opportunities. The majority of smallholders receive limited attention from researchers and extension agents. The effect of this exclusion stretches further than simply being deprived of extension services. Pushing subsistence farmers into the neo-liberal market system increases their dependence on the government (for credit and inputs) and the market. Farmers feel the pressure to invest in seed and fertiliser. Already vulnerable farmers risk to lose valuable assets and become indebted if their harvest fails or demand drops. Additionally, the social status of farmers who are not able or willing to participate in government or AR4D programmes is further downplayed because of their perceived lack of commitment to these programmes. The limited space for non-participation places such categories of farmers in a difficult position, whereby the only option for expressing their dissatisfaction may be in devious ways, also called strategies of ‘everyday resistance’ (Scott 1985).

The mutually dependent relationships in which farmers, researchers and local authorities are entangled are reinforcing the status quo. As long as the underlying incentives and sanctions remain unchanged, none of the actors is likely to break this entanglement. External AR4D initiatives that are blind for these underlying mechanisms are likely to contribute to the perpetuation of the process of social exclusion and marginalisation.

Implications for practice and further research

To break the reproduction social exclusion it is important for AR4D initiatives and impact investors to reflect on their own role in addressing the underlying mechanisms that cause social exclusion. In the following I summarise the main implications of my findings.

<u>Technology and adoption: from quick fix to sociotechnical networks</u>

Moving away from perceiving technology as a technical fix and applying socio-technical network approaches, opens up the opportunity to move away from the overt focus on on-farm trials, towards a more diverse pallet of approaches such as network analysis and analysis of access dynamics. Considering technology as a sociotechnical network also points to the need to move away from a single focus on simplistic indicators such as adoption rates or farmer participation in trials. Instead, alternative indicators are needed which help to increase the understanding of the process of technology promotion. Lastly, considering issues such as (constraints in) access to land, oxen, labour, financial capital and pre-existing social relations as part of the sociotechnical network, implies that AR4D initiatives would promote agricultural technologies which are affordable and appropriate for farmers with diverse socio-economic conditions and networks.

<u>From context to core: consider power and politics for effective AR4D</u>

Given the current situation in Ethiopia, participatory approaches in AR4D (CASCAPE included) are ineffective to assess farmers' perspectives, needs or feedback on introduced technologies. Moreover, they will most likely not lead to empowerment because there is no equal level playing field between marginalised groups and local elites/authorities. To be able to meaningfully participate in and benefit from AR4D initiatives, an equal level playing field should be created first. Impact investors and AR4D initiatives need to reflect on their own role in relation to (local) partners, acknowledging that they are part of a larger arena of power structures and have a responsibility in addressing these. A proper power analysis would help to uncover underlying sociotechnical structures that inhibit change, and (latent) opportunities to ban exclusionist practices. Part of such power analysis is also an assessment of the political will among powerful players (including impact investors) to address power dimensions and change the status quo.

Chapter 1

Introduction

This introduction starts with my personal motivation to engage in a PhD trajectory. In the following I briefly describe the problem statement of this thesis by outlining the local context of agricultural technology promotion in Ethiopia (1.2) and the changing global context of agricultural research for development (1.3). In section 1.4, I present the theoretical framework, followed by a section on the research questions (1.5). In section 1.6 I outline the research methodology and structure of this thesis and finally I discuss ethics and my own position in this research in section 1.7.

1.1 Personal motivation

My experience in AR4D and technology promotion

In 2011 I started to work for the CASCAPE programme: CApacity building for evidence-based SCAling up of best Practices in agriculture in Ethiopia. This Agricultural Research for Development (AR4D) programme is financed by the Royal Netherlands Embassy in Addis Ababa and managed by Wageningen University and Research. The CASCAPE programme aims at the introduction of modern agricultural technologies to smallholder farmers in order to increase food crop productivity in 60 high-potential districts. CASCAPE has often been described as a ‘speed-boat’ which would provide evidence-based recommendations to the ‘mothership’, the Agricultural Growth Programme (section 1.3). As such CASCAPE was not mandated to directly engage technology scaling or poverty eradication, but rather in capacity building of local stakeholders to do so. Participatory research approaches such as participatory rural appraisal, participatory variety selection, farmer preference analysis, on-farm demonstrations and field days were at the core of this programme

(Elias and van Beek 2015). As a social scientist working at Wageningen Centre for Development Innovation (WCDI), I advised the project on socio-economic issues and was a member of the programme's management team in Wageningen between 2011 and 2016[1]. During my involvement in CASCAPE I had the opportunity to experience how agricultural research for development works in practice. I learned how to collaborate with people with different scientific and cultural backgrounds. The dedication of my colleagues in Wageningen and Ethiopia to improve the lives of smallholder farmers highly motivated me to constantly question my own knowledge, perceptions, biases and attitudes towards agricultural research and rural development. It turned out to be a wonderful learning environment for me. I also faced some challenges, which I will outline below.

Farmers as subject

As social scientist, I was taught to distinguish between different social categories of farmers, to understand how these categories relate to each other, and how they are included or excluded from participation and benefits from development initiatives. Along the way I understood that for many of my colleagues, instead of the *farmer,* the *field* was the most important subject of their research. The social scientist in me could not help but noticing how the CASCAPE programme - through its selection of participants and beneficiaries - seemed to contribute to the social exclusion of a large group of smallholders. At the same time, a small group of better-off farmers

[1] Phase I of CASCAPE was from 2011-2015 and phase II is still on-going (2016-2020).

(called model farmers) received technical support, training, and in-kind financial support, such as the farmer on the right in Figure 1.

Figure 1 A farmer (on the right) discussing with DAs in one of the CASCAPE villages
Source: Marielle Karssenberg, 2016

Social relations and politics

Another issue that often confused me was the difference between formal events and the casual interactions I had 'off the record' with farmers, researchers and local authorities. The longer I was involved in CASCAPE, the more I perceived formal events such as field days or field visits as a 'play' whereby the farmer's field was the 'stage', and each actor performed his or her role. In formal settings only people with a high social status raised their voices (Figure 2). It was only in informal settings that I started to realise that at all levels, the relations among key actors in the daily reality of agricultural research and extension are far from straightforward. Worldviews, ethnicity, culture, social relations, disciplinary backgrounds, vested interests, incentives and previous or personal relations played a role in routine decision making in the programme. How was I supposed to navigate in this situation which appeared to be full of (largely invisible) interests that influence daily interactions and decisions?

Figure 2 Farmers interviewed by journalists (left) and myself (right)
Source: own pictures taken in 2016

Context or core?

A third issue that sometimes kept me awake at night was what to consider as the core of CASCAPE and what to consider as external context. As an AR4D programme, CASCAPE was encouraged by the Netherlands Embassy to demonstrate development outcomes such as increases in adoption rates and food and nutrition security. Particularly in the first years of the programme, CASCAPE did not consider issues like adoption and scaling as part and parcel of the programme but confined its research scope to the validation of new varieties and agronomic practices measured by yields and, sometimes economic profitability (chapter 3). Issues such as access to knowledge, inputs and markets were often discussed in internal meetings. However, the majority of the CASCAPE staff and management did not perceive these issues as inherent components of the introduced technologies but as issues which were part of the 'enabling environment' and as such beyond the mandate of the CASCAPE programme.

The more I realised how little I knew about the local realities that influenced our programme, the more I began to wonder how to be a good practitioner in the field of AR4D. It also made me eager to explore how academic literature could help to structure my thoughts regarding these complex encounters. This has formed the basis for my motivation to engage in a PhD trajectory. I felt a strong need to reflect in a systemic and structured way on socio-political factors in AR4D such as reasons for farmer selection, dynamics around accessing, and the role of networks and opinion leadership in agricultural technology promotion.

1.2 Agricultural technology promotion in Ethiopia

Ethiopia is one of few African countries that placed agriculture at the forefront of its economic development policies, not only in rhetorical sense but also in terms of investments. Unlike many countries where public investments in agricultural research and extension were drastically reduced in the 1980s and 1990s (Zhou and Babu 2015), Ethiopia's government has been investing significantly in agricultural extension. It is one of only four African countries to have implemented the Comprehensive Africa Agriculture Development Programme (CAADP) agreement of earmarking 10 percent of their annual government expenditures for agriculture over the 2003–2013 period (Berhane et al. 2018).

Ethiopia's investments in agriculture are heavily supported by a wide range of actors including international research organisations, foundations, multi- and bilateral donors and, last but not least, the diaspora. To give an idea of the magnitude of the Official Development Assistance (ODA): Ethiopia is topping the worldwide list of countries receiving aid from the USA, UK, and the World Bank. Furthermore, Ethiopia has been receiving an annual average of 3.5 billion USD from international donors in recent years, which represents 50 to 60 percent of its total national budget (Oakland Institute 2013).

With the global trend of decentralisation of public services, Ethiopia's research and extension system has also evolved from top-down and managed by the federal ministry to a system that is owned and operated predominantly by the Regional governments and *Woredas* (districts) (Berhane et al. 2018). Consequently, agricultural research is currently mainly undertaken by the numerous regional research stations, which are established based on the 17 agro-ecological zones in Ethiopia (Kassa and Alemu 2016). A consistent element of the research and extension system has been the promotion of agricultural technology packages consisting of a combination of seed of an improved variety, an appropriate fertiliser recommendation (NPS and urea) and agronomic practices (row planting, appropriate spacing, weeding, etc). In the promotion of technologies, agricultural extension agents (DAs) play a major role through the dissemination of knowledge and promotion of seed of improved varieties and fertiliser. Seed and fertiliser are currently supplied by the state through seed and fertiliser cooperatives and unions[2].

In the past decades, the country has made significant progress in terms of economic growth, agricultural development, and poverty reduction (Tigabu and Fetien 2018). While the country faced an average annual economic growth of 7-10% between 2004-2014, real agricultural output grew on average by 7.6% per year over the same period (Bachewe et al. 2018). Rural poverty was reduced to 30% (Table 1). Table 1 shows that the poverty headcount ratio and the rural poverty line are currently lower than that of Kenya and Rwanda, countries with which Ethiopia is often compared.

Table 1 Facts and figures on agriculture and development in Ethiopia

	Ethiopia	*Kenya*	*Rwanda*
Poverty headcount ratio at 1.90$ a day (%)	30.8 (2015)	36.8 (2015)	55.5 (2016)
Rural poverty line (%)	30.4 (2010)	49.1 (2005)	n/a
Prevalence of severe wasting among children under 5 years (%)	2.9 (2016)	0.9 (2014)	0.6 (2015)
Fertiliser consumption per unit of arable land (2016)	14	38	11

Poverty headcount ratio: percentage of the population living on less than $1.90 a day at 2011 international prices. Rural poverty headcount ratio: percentage of the rural population living below the national poverty lines. Prevalence of severe wasting: proportion of children under age 5 whose weight for height is more than three standard deviations below the median for the international reference population ages 0-59. Fertiliser consumption: Quantity of plant nutrients used per unit of arable land (World Bank 2018).

The numbers are impressive, in particular when placed in historical context of the 1970s and 1980s when Ethiopia was known for its disastrous famines. However, the literature also points to certain

[2] For some crops and seed varieties (for instance hybrid maize), private sector seed producers also play a role.

contestations, in terms of how these data were collected as on how to interpret them. First, while there is general consensus about the increase in number of people using fertiliser and seed of improved varieties over time (Table 2), there is less consensus about the effects of this on agricultural productivity and poverty reduction (Elias et al. 2016).

Table 2 Use of inorganic fertiliser and seed of improved varieties in Ethiopia

	2004-2005	*2013-2014*	*2017*
% of farmers using inorganic fertiliser	46	76	64
% of farmers using seed of improved varieties	10	21	39
% of area planted with seed of improved varieties	4	10	n/a

Source: 2004-2005 and 2013-2014 (Bachewe et al. 2018), 2017 (Tigabu and Fetien 2018)

Furthermore, the amounts of fertiliser and seed of improved varieties that farmers apply are still rather low (Abebaw and Haile 2013), for instance in comparison with Kenya (Table 1). Moreover, Bachewe and his colleagues (2018) argue the increase in use of seed of improved varieties seems to be explained especially by the rapid increase of the use of hybrid maize seed; the same trend is less prevalent in other crops (Bachewe et al. 2018). Additionally, the increase in agricultural output that Ethiopia has reported is primarily caused by the expansion in cultivated area and labour productivity. Only partially can this increase be explained by the increased use of seed of improved varieties and inorganic fertiliser (Berhane et al. 2018). Also the Ethiopian government itself acknowledges that the uptake of agricultural technology packages among smallholders remains limited (ibid.). Finally, some authors point to the need to critically reflect on the reliability of the data collected by the Central Statistical Agency

(Bachewe et al. 2018; Cochrane and Bekele 2018; Sandefur and Glassman 2015).

Besides these mixed signals in terms of agricultural productivity and the effectiveness of the agricultural research and extension system, there are a number of other reasons that make Ethiopia an interesting country to study the social and political dimensions of agricultural technology promotion. The fact that Ethiopia has never been colonised makes the country unique in its relations with bilateral donors, financial institutions and international research for development initiatives. More importantly, the agricultural research and extension agenda has been reported to be closely intertwined with the political project of securitisation in rural areas (Adem 2012; Berhanu and Poulton 2014), which may have significant ramifications for how agricultural research and extension is organised and practiced at different levels.

1.3 AR4D at a crossroad

Changing AR4D context

The CASCAPE programme has been taking place in a changing international context which can be characterised by the rise of the participation agenda, increasing private sector influence and a growing donor focus on generating large scale farmer impact (Giller et al. 2017; Sumberg and Thompson 2012). In line with this, impact statements of AR4D programmes are often framed in the language of the Sustainable Development Goals, including references to 'zero hunger' 'ending poverty', 'reducing inequalities' or achieving 'gender equality'. This also counts for the increasingly popular concept of ‘food systems transformations’ (Béné et al. 2018). AR4D organisations are increasingly encouraged to demonstrate impact at scale, preferably – and in the majority of the cases – as quickly and efficiently as possible (Glover et al. 2016). Many funding agencies base their investments on how effectively research contributes to metrics of use, as evidenced by funders’ use of terms like ‘outcome investing’ (BMGF 2017) and ‘value for money’ (Jackson 2012). Consequently, donors increasingly request AR4D initiatives to report research results which are outside direct agronomic research efforts, such as ‘farmer adoption’, and ‘farmer incomes’. For instance, the second phase of the CGIAR Research Programme hypothesises that 350 million farmers will *adopt* improved agronomic practices and varieties by 2030 (CGIAR 2016). Critics point to the risks of pushing simple metrics, because they are thought to downplay the ground realities which are inherently iterative and complex (Kiptot et al. 2007; Glover et al. 2016).

A major consequence of the changing AR4D environment is that agricultural research has become less and less controllable. Obviously, agronomy has never taken place in controlled laboratories, but the new research setting implies that the domain of research now includes a wide array of disciplines and actors (both scientific and non-scientific) who interact with each other in iterative ways. This new scope raises the need to reflect on the role of on-farm validation and demonstration trials as dominant modality in AR4D (Andersson and D’Souza 2014; Glover et al. 2017).

Amplifying actors and scope: political dimensions

The new funding environment with its focus on impact at scale implies that AR4D initiatives have come to include not only other activities and scientific disciplines (e.g. economy, rural sociology), but also other actors (e.g. extensionists, scaling partners, donors, local authorities, farmer cooperatives, agri-businesses, etc). AR4D actors are no empty vessels; they have worldviews, interests, histories, and power positions (Long 2001; Mosse 2005). This is also true for researchers. The involvement of new or more diverse actors will make AR4D processes more political in nature (Andersson and Sumberg, 2017). Politics take place at different levels. For instance, in an in-depth research on a large AR4D programme in Mexico, Martinez-Cruz (2019) demonstrated how researchers, farming communities, donors and other actors were constantly engaged in negotiations to advance their (diverse) interests. Her research showed how these politics affected the AR4D programme and its outcomes in terms of inclusion and exclusion of certain societal groups (Martínez-Cruz et al. 2019). At the level of a research community, Andersson and Giller analysed the political dynamics of conservation agriculture, a set of agronomic practices which is being promoted by scientists and NGOs in sub-Sahara Africa. Their analysis demonstrated the silencing effect that a powerful epistemic community can generate as they pursue a specific policy enterprise (Andersson and Giller 2012). Power play between actors may also take place at the community level, as shown by Arora in an in-depth study on the introduction of integrated pest management practices in India. His study detailed out how social ties and interests of community members mediate the diffusion of pest management technologies (Arora 2012a). At this local level the phenomenon of elite capture is also relevant, whereby local elites strategically influence development initiatives and the distribution of benefits from these initiatives (Hoang et al. 2006; Platteau and Gaspart 2003). These political dynamics may not all be new, but their relevance increases as the balance of AR4D initiatives shifts from research to development.

The changes in context, and the way AR4D initiatives reacted to these changes, have given rise to several contestations. The contestations in the domain of conservation agriculture are a good example (Erenstein 2012; Giller et al. 2009; Martinez-Cruz 2020). The increasing amount of internal discussions raised the need among the agronomic community and related fields to critically reflect on agronomy as scientific field and to acknowledge the social and political dimensions of agronomic research. A body of literature is emerging that explicitly studies the social and political dimensions of agricultural research for development, coined Political Agronomy by Sumberg and Thompson (2012). Using such a Political Agronomy lens opens the possibility to explore the role of the socio-political context in which AR4D practices and encounters are embedded.

Many AR4D initiatives, including CASCAPE, struggle with this shift from research to development, precisely because the socio-political context in which new technologies are being promoted has so far been considered to be ‘external environment’ and has thus been placed outside the research frame (Leeuwis et al. 2017). In policy circles this dilemma is sometimes framed as a so-called strategic choice between food security or poverty alleviation. While this dilemma is real and important in national and international policy environments, in this thesis I focus on the effects of these decisions at project and community level. Taking the experiences of the CASCAPE programme as case, I aim to understand how socio-political factors influenced the interactions between actors involved in the CASCAPE programme, with a particular focus on social exclusion of marginalised groups during the process of technology promotion.

1.4 Theoretical considerations

Inspiration for this thesis

For this study on socio-political dimensions of agricultural technology promotion in Ethiopia I have been loosely inspired by Political Agronomy, an emerging field consisting primarily of a collection of case studies aiming to unpack the black box of agronomic knowledge production by acknowledging that agronomic research is a socially and politically embedded practice (Thompson and Sumberg 2012). Political Agronomy heavily builds on concepts developed by Science and Technology Studies (STS) and Political Ecology. Using these two fields as entry-point, I discuss the relevant literature in relation to the main concepts that I am using in my thesis: technology, technology promotion, power and inequality, marginalisation and social exclusion, and access.

Technology

One of the major insights that STS has brought to the foreground is that scientific knowledge is the outcome of messy and situated practices shaped by historical, social, political and socioeconomic contexts. STS scholars argue that one technology is not better than another because of its inherent superiority, but because it is *perceived* as superior, which is the result of social processes (Bijker et al. 2012). STS has also advanced our understanding of the relation between technology and society. Technology has long been portrayed as an external, fixed and mobile force that impacts upon society (i.e. independent of that society) (Heilbroner 1994). Such a view implies technology as neutral, free from politics or other social processes. STS scholars object to this deterministic view of technology (see for instance Winner 1980). Some STS scholars have moral objections, arguing that this view of technology has become synonymous for progress, modernity, and rational decision making which is being imposed on the world (Feenberg 2017). Others prefer to conceptualise technology, society and their mutual relation broadly as sociotechnical configurations that work (Rip and Kemp 1998). I go along with this conceptualisation. For me, artefacts (objects) are material components of technology, but so are immaterial components, such as social relations, and heterogeneous components (such as infrastructure or networks). These components of the technology are (re)configured through interactions with society, to make the new situation work, or to make the technology work (Klerkx et al. 2010).

Technology promotion

The concept of scaling has recently gained traction among impact investors in AR4D (see also section 1.3). Consequently, whether appropriate or not, scaling has come to replace others like technology diffusion, technology promotion, and outreach. One of the complications with the use of scaling is its position in relation to the dominant notion of transfer of technology (in public agricultural research) or innovation funnel (in the business sector) (Mortara et al. 2009). Technology transfer suggests that scaling can be reduced to a technical procedure, which raises the question on what is being scaled exactly: an artefact, a practice, a methodology, an outcome, or an entire system? At the moment, there is no clear consensus on the operational meaning of the term scaling (Wigboldus 2019).

Moving away from the fuzzy debate on scaling, I prefer the more empirical notion of 'technology promotion' to refer to the process of the introduction of agricultural technologies (consisting of material and social components) in a given context[3]. The emphasis on *promotion* does justice to the observation that the process is inherently normative, in the sense that its promotors claim that the technology is good and we need more of it. Furthermore the process of technology promotion may include adapting certain components of the technology to the intended user group(s).

In my view, the process of technology promotion heavily depends on sociotechnical configurations that need to be forged or altered (Rip and Kemp 1998), including existing social, economic and political structures and patterns of behaviour between people (Arora 2012b; Cleaver 2005). This makes technologies and their promotion context specific: the outcome will not be the same in different places or times.

[3] Having said this, in chapter 3 and 4 I use the term scaling in the title. This was done because of pragmatic reasons. Chapter 3 was presented at a conference on a panel about scaling in agriculture (Contested Agronomy, 2016). Chapter 4 was published in a special a special issue on Science for Scaling in Agricultural Systems.

Power and inequality

STS is best known for its focus on devices and study of the natural sciences in the Western world. Besides a few exceptions such as the work of Akrich (1992) and Laet and Mol (2000), STS has limited application in agriculture in low and middle income countries (Khandelar et al. 2017). Another limitation of STS is related to power dynamics, which is an important topic in this thesis. In the past, critics pointed out that STS scholars tended to ignore the importance of structural inequalities (e.g. ethnicity, gender, class) and social exclusion by discussing power in Machiavellian language and portraying power in simple terms of 'power over' (Goldman and Turner 2010). Indeed, one of best known references that the earlier STS scholars made to power may be the notion that technology is not neutral (Winner 1980). Actually, more recent STS studies are interested in studying why certain artefacts become accepted, as well as the (intended and unintended) social consequences of sociotechnical change. A nice example that illustrates this point is the development and introduction of the tomato harvester in California, USA, causing a reorganisation of agriculture which favoured large scale mechanised agriculture over labour intensive and small scale farming (Carlisle-Cummins 2015). However, in such studies the underlying mechanisms that reinforce inequalities often receive limited attention; and if so mostly as an outcome and not as a cause.

Some exceptions have emerged within STS devoting explicit attention to power and systemic inequalities. One of these exceptions is feminist STS scholarship, which has addressed systemic inequalities and their relation to sociotechnical configurations (Haraway 2013).

Another exception is the multi-level perspective (MLP) originally developed by Geels (2002), which perceives sociotechnical change as an evolutionary process in which the ‘strongest’ alliance survives (Geels and Schot 2007). ‘Strongest’ is tautologically defined as ‘that what wins’. As such this framework, however interesting, is of limited use in studying the mechanisms that underlie power and inequality. A final recent exception is an emerging field within STS called Responsible Research and Innovation (RRI), which has gained particular visibility in the EU. One of the principles of RRI is inclusiveness, implying that all relevant actors (scientific and non-scientific), should be included in the research process (Owen et al. 2012).

Political Ecology employs a multi-faceted view on power (Avelino 2017; Partzsch 2017). Where the outside world often speaks of a binary distinction between winners and losers, political ecologists argue that power is not a zero-sum game, but has different levels, spaces and forms. The notion of power over (dominance), power to (the capacity to act), and power with (the capacity of collective action) is often used in Political Ecology analyses (Partzsch 2017).

Marginalisation and social exclusion

Political Ecology uses the term marginalisation (rather than social exclusion) to describe the process that leads to increasing impoverishment and deprivation. Political ecology places particular emphasis on the environmental effects of marginalisation, as it often relates marginalisation to land degradation (Robbins 2012). The concept of social exclusion has, until recently, mostly been discussed in the context of developed countries, notably USA and the UK (see for instance the Special Issues of *Sociologica Ruralis* of 2004 and 2012). Social exclusion is often defined in relation to poverty, whereby the concept of social exclusion is generally considered helpful in understanding (1) the multiple dimensions of deprivation that people experience (social, economic, political, cultural), (2) the dynamic processes causing deprivation, and (3) the relational (and not individual) aspects of deprivation (Fischer 2011; de Haan 2000). Poverty on the other hand, is often defined as a state, an outcome, for instance the number of people who live below a certain income threshold. Furthermore, social exclusion is useful for capturing exclusionary dynamics among people of a similar social category (Saloojee and Saloojee 2011).

Besides some small differences in nuance and emphasis, the concepts of marginalisation and social exclusion are rather similar since they are both used to study social processes resulting in the deprivation of groups from (access to) certain benefits, resources or positions. In this thesis I am using the definition of social exclusion coined by Fischer: "structural, institutional or agentive processes of repulsion or obstruction" (Fischer 2011, p.17). This definition stipulates that social exclusion is a process, in the sense that it does not refer to a condition of being excluded in an absolute sense, but that certain processes affecting a person's condition are exclusionary, in combination with others that might be inclusionary or neutral. The first part of the definition is based on the idea that structure, institutions and agency constitute the key mechanisms driving exclusion. This is in the line of thinking of the structuration theory of Anthony Giddens, who describes agency as the ability of actors to manoeuvre within structural constraints and thereby also influencing this structural environment (Giddens 1986). The terms 'repulsion' and 'obstruction' in the second half of the definition of social exclusion specify that exclusion involves either outright repulsion from positions of access and/or benefits, or else the indirect obstruction of access, entry or upward mobility. In this thesis, and particularly in chapter 4 when unpacking the mechanisms of access, I analyse the direct exclusion from access and benefits, as well as indirect obstructions which are socially mediated. Finally, the consideration of structural and institutional processes also allows for non-intentional exclusion.

Access

Building further on the above, access is another concept for which Political Ecology provides useful insights. Political Ecology literature postulates that access is not something that can be simply provided or engineered from outside, but involves complex socio-political dynamics of inclusion and exclusion, see for instance Berry (1989); Milgroom (2012); and Ribot and Peluso (2003). In their 'Theory of access', Ribot and Peluso define access as the ability of people to benefit from things—including material objects, people, institutions, and symbols (p.153). They further use the notion of 'webs of access' (p.154) to refer to the dynamic political and social processes and relationships that shape access to resources (Ribot and Peluso 2003). However, since their domain is that of natural resource management, Ribot and Peluso frame access to technology, knowledge, and markets merely as means for exploiting natural resources. In this thesis I am applying the 'theory of access' as developed by Ribot and

Peluso to the domain of agriculture and technology promotion (in chapter 4).

Convergence of STS and Political Ecology: Political Agronomy

Originating from cultural ecology and critical social studies, work within Political Ecology has focused primarily on the power and politics that surround environmental change, conservation efforts, and natural resource economies (Robbins 2012). Consequently, Political Ecology analyses paid less attention to the politics of (environmental) knowledge production. However, recently Political Ecology has started to expand to the field of environmental knowledge production, and thus becomes linked more closely to STS and its vocabulary as well (Goldman and Turner 2010). In turn, with feminist STS and RRI, STS has started to embrace the ethical and political dimensions of technology-society interactions and as such moved closer to Political Ecology.

For me Political Agronomy combines one the one hand insights of STS on technology-society, networks, and the politics of knowledge production, and on the other hand the lens of Political Ecology with its focus on power relations and processes of social exclusion and marginalisation (Figure 3). In this thesis I will apply these concepts to the domain of agricultural technology promotion. The perspectives of STS guide me to explore the relation between technology and society and the role of networks in the agricultural technologies that I am studying. The lens of Political Ecology has inspired me to keep in mind questions such as: ‘Why do actors make the decisions they make?’, ‘Who benefits from the status quo and why?’, ‘What is the (power) relation between the state, private sector and civil society actors?', 'How do these relations influence the choices made by each actor?' (Robbins 2012).

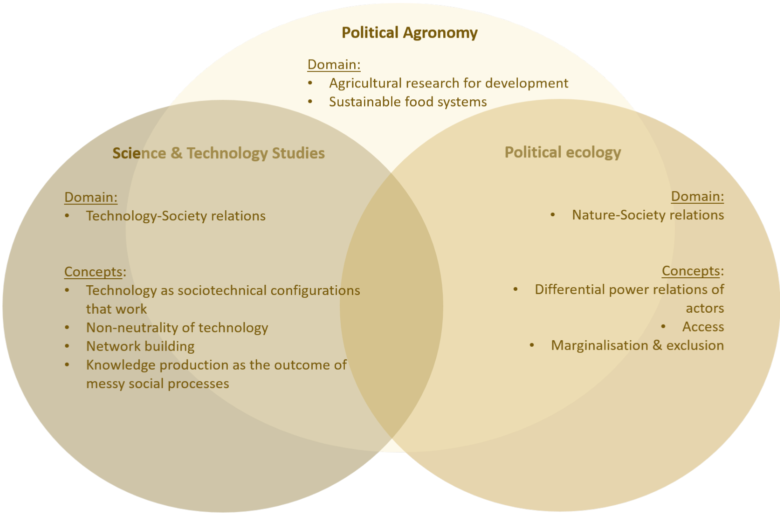

Figure 3 Academic fields and concepts that inspired this thesis

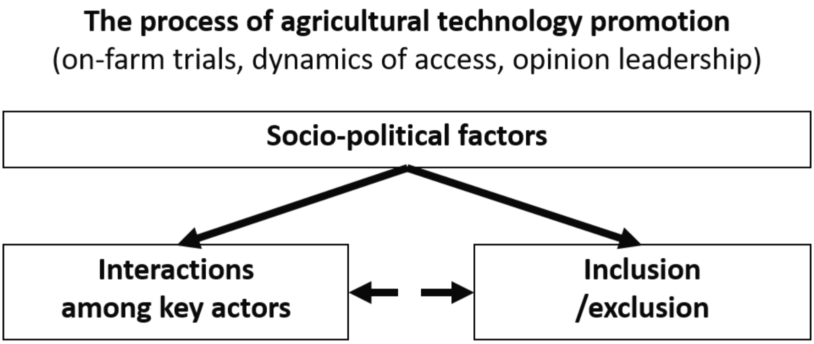

Figure 4 Main variables and dimensions of agricultural technology promotion

1.5 Research question and variables

Research questions

The central research questions of this thesis are: How do socio-political factors shape interactions between key actors involved in the process of agricultural technology promotion in Ethiopia and how does this result in inclusion and exclusion?

The main variables and their relation are outlined in Figure 4.

Socio-political factors are hypothesised to influence both the interactions between key actors and social inclusion/exclusion. Interactions between key actors during the process of agricultural technology promotion result in the inclusion of some groups and the exclusion of others. Structural, institutional and agentive processes of repulsion or obstruction (i.e. social exclusion) influence the interactions between actors as well during the promotion of agricultural technologies. Inclusion and exclusion are thus both an outcome and a process, hence the two-sided arrow in Figure 4.

To my knowledge, CASCAPE did never precisely define technology and scaling; rather the programme aligned with the Ethiopian government in promoting so-called agricultural technology packages including a recommended seed variety, fertiliser type and quantity, agronomic practices such as row planting, plant density and spacing, and weeding methods. As outlined in section 1.4 I use a different definition of technology which captures both the material (seed, fertiliser, oxen plough, etc) and immaterial components (knowledge, networks, access, etc).

For pragmatic reasons, in this thesis I operationalise technology promotion as the process of introducing agricultural technologies in a new area. CASCAPE distinguishes different phases during technology promotion, namely adaptation, demonstration, pre-scaling, scaling pilot and regular extension. In CASCAPE, technology promotion is a so-called 'up or out' process, whereby each stage results in a decision to either promote the technology to the next phase, or drop the technology entirely[4]. Rather than the *phases* that CASCAPE distinguished, I zoom in on three process dimensions of technology promotion: on-farm trials, dynamics of access and opinion leadership (Figure 5).

This thesis is not an evaluation of the CASCAPE programme and how it relates to the wider policy context of the Dutch foreign policy framework. Diverse positive effects of the programme have been published in annual reports and elsewhere, in terms of its contribution to increased agricultural productivity at the local level, increased capacities of actors and networks involved in agricultural technology promotion, and its contributions to evidence-based policy recommendations on agricultural policies (Haileyesus et al. 2020; Wageningen University and Research 2016). Rather than evaluating and measuring the effectiveness of the programme in terms of increases in agricultural productivity, or in terms of strategic positioning as a research project that was intended to feed the larger Agricultural Growth Programme with promising approaches to promote agricultural technologies, I am using CASCAPE as case study to explore how socio-political factors shape the interactions between

[4] More details on this process are given in chapter 3 where I study in detail the process of technology promotion through on-farm trials in CASCAPE.

key actors involved in the process of agricultural technology promotion in Ethiopia and how this results in inclusion/exclusion. In doing so, I focus mainly on socio-political dynamics at the project and community level, thereby putting less emphasis on the wider policy context at national and international level and the potential trade-offs at these levels.

Structure of this thesis

Although there are many actors involved in the process of agricultural technology promotion, I focus on the interactions between three types of actors: the farming community, researchers, and local authorities (including DAs).

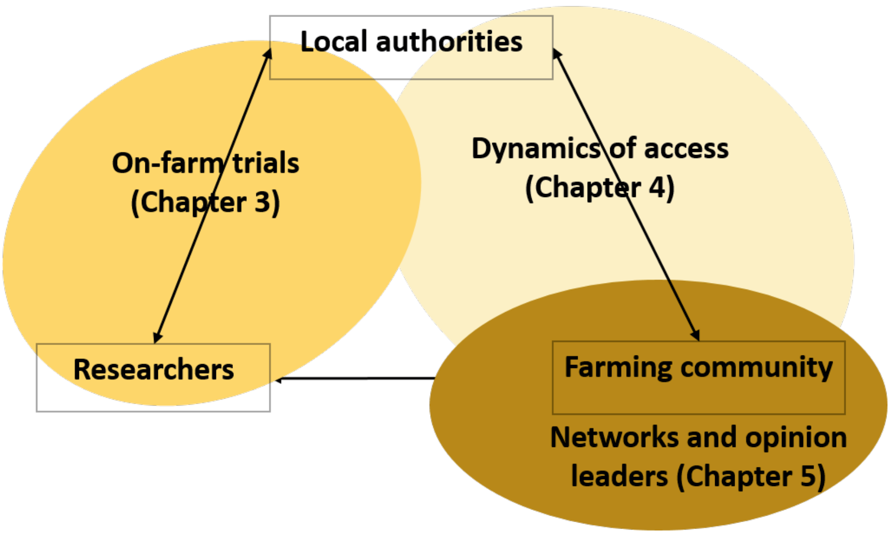

Figure 5 Structure of this thesis

In each of the chapters the interactions between one or more of these groups in relation to one particular process dimension of agricultural technology promotion is explored (Figure 5). Furthermore, to reduce the complexity of my case studies I made the choice to focus on a limited number of process dimensions and focus on one process dimension in each empirical chapter (chapter 3, 4, and 5).

Chapter 2 is a structured literature study with the aim to provide an extended introduction to the socio-political context in which the promotion of agricultural technologies is embedded in Ethiopia (chapter 2). This chapter provides the basis for the other empirical chapters.

The first case study (chapter 3) zooms in on the social and political dimensions of the organisation of on-farm trials. On-farm trials, which may include adaptation, validation, demonstration and pre-scaling trials, are an immensely popular method in technology promotion (Vanlauwe et al. 2016). Its popularity can be explained by the commonly held notion among agronomists and extensionists: 'seeing is believing'. This implies that the use of on-farm trials and demonstrations enables farmers to observe with their own eyes how certain varieties or practices perform on their own farm (or their neighbour's). On-farm trials are considered more appropriate than on-station trials in the AR4D community, because farmers' fields are thought to be more representative for the reality of smallholders' lives. In this chapter I analyse this premise by looking at the role of on-farm trials in agricultural technology promotion, using the case of the CASCAPE programme. This chapter also includes an analysis of the role of on-farm trials in two other AR4D programmes, one in Southern Africa and one in Bangladesh, respectively. The research for these two other programmes was conducted by the co-authors of this chapter, Jens Andersson and Tim Krupnik.

The second case study (chapter 4) is an in-depth analysis of another process dimension of agricultural technology promotion: access to (components of) agricultural technology, including efforts to enhance farmers' access to agronomic knowledge, input markets (seeds, fertiliser, pesticides, manpower, credit, etc.) and output markets access. This chapter is included because the dynamics around accessing are not well researched in the context of agricultural research and extension for development. Unpacking the concept of access is relevant, given the high expectations that policy makers and the donor community have for the successful promotion of improved agricultural technologies as key towards food security and poverty reduction. More specifically, in this chapter I analyse how the dynamics of access influence inclusion and exclusion of certain groups of farmers during the promotion of the malt barley technology package as introduced by the Ethiopian government and CASCAPE in 2012 in Guguma and Gomeshe-Tulu in the South of Ethiopia. This case study focuses on the interactions between farmers and local authorities (including local administrators and DAs).

The last case study (chapter 5) is included to dive deeper into a third process dimension of agricultural technology promotion: the role of opinion leaders and social networks. The process of technology promotion is often considered to be supported by opinion leaders, who have the ability to influence others' attitudes and knowledge (Feder and Savastano 2006). Many AR4D initiatives in LMIC work with the so-called model farmers approach, reasoning that when appointed opinion leaders are satisfied with a new technology, others will follow them sooner or later. While much research has been done regarding the effectiveness of this approach in health care (van Griensven and Kalichman 2007; Valente and Davis 1999), there is limited empirical research on the effectiveness of this approach in disseminating agricultural technologies in LMICs, in particular in contexts where access to markets and inputs is constrained. In this chapter I am particularly interested in the social networks of farmers and less in the interactions between farmers and researchers or farmers and local authorities. I try to unravel the role of two types of opinion leaders in the exchange of knowledge and uptake of the malt barley technology package: model farmers who are appointed top-down by local authorities and nodal farmers, who emerge from within the community.

In the last chapter of this thesis, the discussion, I synthesise the main findings of the empirical chapters. I will also describe the implications for policy and practice and the final conclusions.

1.6 Research methodology

Research approach

To understand how socio-political factors influence interactions between key actors and their effect on inclusiveness in Ethiopia, I used a case study approach (Yin 2009). My research was exploratory in nature, for which a case study approach is most appropriate.

Data collection

I used several data collection techniques to construct the four empirical chapters of this thesis (Table 3).

Chapter 2 is a literature review, for which I collected and reviewed different academic and policy documents. For chapter 3 a variety of data collection methods is used. My own ethnographic documentation and field notes served as a basis. Furthermore, I interviewed purposively selected programme staff. Lastly I analysed documents of the CASCAPE programme (mainly annual reports and project design documents). For chapter 4 and 5 I conducted two periods of ethnographic fieldwork in Guguma and Gomeshe-Tulu, two neighbouring villages in Sidama Zone, in the South of Ethiopia. I selected these two villages for two main reasons. Firstly, they were research sites of the CASCAPE programme for technology validation and scaling of malt barley, which made it appropriate to study the scaling process. It gave me direct access to programme resources (including a lift to and from the village when needed) and networks that provided a smooth entry in the village. Secondly, at the time of site selection, my local supervisor was also the CASCAPE programme coordinator in the South. This enabled me to select a study site within his mandate so that he could help me to interpret some of the encounters that I had had. Lastly, this study site was reasonably close to the capital of the South which made it pragmatic to come back and revisit once my fieldwork had ended. The fieldwork periods lasted from July-August 2016 and August-September 2017. Due to the high agroecological and cultural diversity of Ethiopia, the study sites are not meant to be representative for the Southern region, let alone for the entire country. The literature review was useful for comparing my findings with findings in other areas (notably Amhara, Tigray and Oromiya).

Table 3 Overview of research question and data collection -analysis techniques

Chapter	*Research question*	*Research method*	*Data collection techniques*	*Data analysis techniques*
2: The socio-political context of agricultural technology promotion in Ethiopia	How has decentralisation in agricultural extension been operationalised in rural Ethiopia between 2006 and 2016, and how is this analysed and framed in different bodies of literature on extension practice?	Structured literature review	Literature search in Scopus	Deductive coding
3: On-farm trials for development impact? The organisation of research and the scaling of agricultural technologies	What are the implications of the increased pressure to demonstrate rapid farmer impact at scale for the use of on-farm trials in scaling agricultural technologies?	In-depth retrospective case study	Participant observation; Document analysis; In-depth interviews	Scoring and ranking methods
4: Scaling modern technology or scaling exclusion? The socio-political dynamics of accessing in malt barley innovation in two highland communities in Southern Ethiopia	How do dynamic processes of accessing interact with efforts to foster an enabling environment for scaling modern agricultural technologies?	In-depth retrospective case study	Ethnographic fieldwork; In-depth interviews	Deductive and inductive coding (Atlas.ti)
5: Opinion Leadership under imperfect Market Conditions: the Case of Malt Barley Technology in South Ethiopia	To what extent are appointed model farmers better than others in sharing knowledge about improved agricultural technologies? To what extent does connectedness to knowledge sources result in a higher uptake of improved technologies?	In-depth retrospective case study	Network analysis, quantitative survey; Ethnographic fieldwork; In-depth interviews	Social network analysis (Gephi); basic statistics (SPSS)

During the fieldwork I made notes of informal events and encounters. Particularly the informal encounters during the fieldwork proved to be of great value to unravel social and political dimensions that influence daily routines in the village and the interactions with local authorities and researchers. As the community started to trust me and perceive me as a 'fly on the wall' I could observe social relations which would never have become visible for a random visitor form outside. I was helped by a dedicated translator who spoke the local languages and stayed with me during both field work periods. He was not originally from the village that I selected for my fieldwork and could thus maintain a certain level of independence from the community members. This was a pre-condition for me to select him as my translator. With his support, I also conducted semi-structured interviews with farmers, extension agents and local authorities. In total I conducted 30 in-depth interviews. Lastly, network data were collected through a structured closed questionnaire on knowledge flows between villagers in Guguma. This was done by my translator, who was a MSc student at the Faculty of Development Studies at Hawassa University. I supervised him intensively throughout this period and during data entry and quality control. The data collection methods are described in more detail in each consecutive chapter.

Data analysis

Each empirical chapter has different data analysis methods; the details are reported in the consecutive chapters. For the quantitative elements in chapter 3 I used simple scoring methods. For the case study on the dynamics of access (chapter 4) a pre-coding procedure was used to explore the factors influencing access to the different components of the malt barley technology package. A second coding was done to identify the underlying mechanisms that could explain why certain farmers had access (or not). For the last empirical chapter I used network analysis and basic statistical analysis of quantitative data. For the visualisation of network data and calculation of eigenvector values I used Gephi.

1.7 Ethics and my position

My double role as researcher and advisor has had advantages and disadvantages. As member of the programme I had direct access to internal documents of CASCAPE. I was also present during formal meetings with external stakeholders, internal meetings and informal encounters with programme staff and management. This gave me valuable insights in the arguments and communication styles during these different encounters which I would otherwise not have been able to observe. Furthermore, my role as advisor has helped to get infrastructural support to access two villages for fieldwork and other visits.

One of the possible risks of this dual role was that I might influence my research objects during my research. Surely, I may have influenced CASCAPE programme staff during my advisory work, for instance when I was facilitating trainings and programme meetings on targeting and social inclusion. However, I always clearly communicated my two roles in the programme and always made it explicit when I was wearing my 'researcher' hat and when I was wearing my 'advisor' hat. For instance, if I wanted to ask a question and use the results in my research, I always made this explicit before asking the question. Moreover, I asked for the prior informed consent when I planned to conduct observations during the programme. Before interviews with programme staff, farmers or other respondents I always asked whether the respondents would like to remain anonymous, and I reconfirmed their answer after the interview as well. I asked permission to take pictures and only use pictures for which permission was granted. In some cases farmers and programme staff refused to be interviewed or observed, and in those cases I accepted this. In most cases when the respondents were able to read English, I sent them my interview notes and asked whether they wanted to make corrections or accepted the notes as a proper reflection of the interview. CASCAPE staff was generally very willing to support my research; most researchers were very eager to discuss their work and to share their views regarding the scaling of agricultural technologies.

Chapter 2

The Socio-political Context of Agricultural Technology Promotion in Ethiopia

2.1 Introduction

The paradox of Ethiopia's agricultural extension system

In policy circles Ethiopia is often praised for its commitment to agriculture and its substantive investments in agricultural extension. However, rather than rendering the agricultural extension service more effective and demand-driven, critical voices argue that the investments in extension have resulted in the further marginalisation of already vulnerable smallholder and subsistence farmers.

When the Tigrayan People's Liberation Front (TPLF), later transformed into the Ethiopian Revolutionary Democratic Front (EPRDF) came to power in 1991, they were the first Ethiopian government to place agriculture at the heart of its development strategy (Berhanu and Poulton 2014). Massive investments in agricultural extension were the result, notably in capacity building of local authorities (*Woreda* and *Kebele*) and development agents (DAs). Today, Ethiopia has the highest extension agent-to-farmer ratio in the world: in 2017, more than 72,000 DAs who reportedly served about 16.7 million smallholders (Bachewe et al. 2018).

Like in many other countries, Ethiopia's modernisation of agriculture has been accompanied by the process of decentralisation, which is meant to bring the government closer to its citizens (Hartmann 2008), facilitate rural empowerment and participatory planning (Chambers 1983) and increase efficiency of (agricultural) service delivery (World Bank 1988). The decentralisation process was amplified by new modalities to bring agricultural extension closer to farmers: model farmers and development groups (among others). Model farmers were expected to reduce the workload of DAs and create a more effective learning process through supporting knowledge transfer and technology uptake (Berhane et al. 2018). Development groups were a revitalised form of the indigenous institutions used for collective labour (*dado* and *debo*[5] in Oromiya and Amhara respectively), linking households to the lower tiers of the decentralised governance system (Leta et al. 2018).

A small body of literature, best characterised as the political agricultural extension literature, has been critically following the decentralisation process in Ethiopia, concluding that decentralisation in Ethiopia has been part of a larger effort of nation building (Berhanu and Poulton 2014). According to this body of literature most farmers experience the concept of model farmers and development groups as the umpteenth attempt of the state to increase control on farmers daily lives (Planel 2017). This process is also referred to as *encadrement*. Still, farmers do not resist these institutions openly; instead they seem to contribute to their existence (Adem 2012; Segers et al. 2009). These and other political dimensions of agricultural extension practice do not receive much attention in the regular agricultural extension literature, nor in most agricultural research for development initiatives. This apparent contradiction is the topic of this chapter.

This chapter is a context chapter to the other chapters in this dissertation and as such it serves to provide the historical and socio-political context in which agricultural technology promotion takes place in Ethiopia. The research question is: How has decentralisation

[5] *Dado* is an informal institution that promotes and enforces a reciprocal labour-sharing arrangement where farmers form groups based on trust and confidence (Leta et al. 2018).

in agricultural extension been operationalised in rural Ethiopia between 2006 and 2016, and how is this analysed and framed in different bodies of literature on extension practice?

This literature review was inspired by Political Ecology, an interdisciplinary field originating from cultural ecology and peasant studies concerned with understanding the politics behind environmental degradation and social change (Robbins 2012). A Political Ecology lens brings to the foreground a focus on actors, interests and power relations while discussing recent developments in agricultural extension practices in Ethiopia.

Research approach and data sources

The scope of this literature review ends in 2016 because at the moment of writing this chapter limited scientific data was available covering the period after 2016.

This chapter is a literature review based on different sources. Firstly, the four most relevant policy documents related to Ethiopia's agriculture extension delivery were selected for this review: Plan for Accelerated Growth and Sustainable Economic Development (PASDEP) (2006), Agricultural Growth Programme I (AGP) (2010), and AGP II (2015) and the (draft) Extension Policy (2015). Secondly, I used three sources as background material for the agricultural and political history of Ethiopia in the past century (Annex I). Thirdly, I conducted a literature search in Scopus using the key words 'Ethiopia', 'agriculture', and 'extension services'. This yielded 122 hits (November 4, 2019).

I further refined the selection based on the title and abstract using the following criteria:

- Date: Publication date between 2006-2019
- Quality: Peer-reviewed publications only
- Content: Publications should be about the features, methods and functioning of agricultural crop extension delivery (excluding publications which focused on adoption, productivity, climate change, farmers perceptions, livestock, nutrition)
- Scope: Multiple technologies and/or communities (excluding publications about a single technology, project or community).
- Citation: publications that were cited 10 times or more.

This left me with 10 publications. I checked which references cited the 10 publications (forward reference checking) and all references of the 10 publications (backward reference checking). This yielded in 793 additional literature sources, which I also checked using the same criteria as defined above. This left me with a list of 24 publications.

9 of the 24 mentioned power and or politics in the title or abstract. For those 9 publications I repeated the backward and forward reference checking and the selection procedure. This yielded 806 additional publications, of which 5 remained in the selection after applying the above mentioned criteria. Finally I distinguish two bodies of literature: the agricultural extension literature (24-9=15 publications) and the political extension literature (9+5=14

publications). An overview of the list of selected publications is presented in Annex I.

Data analysis and structure

I started with an analysis of the literature sources from the selected agricultural extension literature and political extension literature using a set of predefined broader questions such as “what is reported on extension policies,” “what is reported on extension practices on the ground,” “what is mentioned on socio-political dimensions.” Furthermore, I structured my analysis around the most often mentioned modalities of agricultural extension delivery (model farmers, development groups, FTCs, DAs, cooperatives, credit). Later on, these modalities formed the structure of this chapter. Lastly, I analysed what both bodies of literature reported on concepts that typically emerge in the Political Ecology literature, such as actors and their coping strategies, power relations, private versus public service provision, and marginalisation. I analysed what each source reported and explored commonalities and contrasts between sources.

In the following section (2.2), a brief overview of the political history of Ethiopia is presented. Where relevant, reference is made to how political changes affected agriculture and the relations between the state and citizens at community level. This is followed by section 2.3 on the most important agricultural policies that were implemented between 1991-2016. In section 2.4 and 2.5 the major modalities of agricultural extension delivery are discussed. In each sub-section of 2.4 and 2.5 I first present the data from the agricultural extension literature, followed by the review of sources from the political extension literature. Decentralisation is a red thread throughout the analysis. In section 2.6 the main findings of the two bodies of literature are compared with each other, followed by the discussion (2.7).

2.2 Overview of political history of Ethiopia

The expansion of the ox plough system (< 1930)

This section is largely based on the comprehensive overview of McCann (1995) called 'The people of the plough, a history of agriculture in Ethiopia 1800-1990'.

The gradual formation of the ox plough farming system in Ethiopia gives a relevant background to some of the major social, political and economic traditions and practices in rural Ethiopia. Highland agriculture originated in the Tigray/Amhara highlands but has over time become the dominant agricultural system in all Ethiopia's highlands. The first evidence of the use of the typical *maresha* plough are from cave paintings in Eritrea, somewhere in the first millennium B.C. (McCann 1995). The expansion of the Northern empire towards the western and eastern parts of the highlands (currently Oromiya and SNNPR) resulted in a shift in farming system from a predominantly pastoral system to a mixed crop-livestock system. The expansion also introduced changes in other dimensions of society: orthodox Christianity, conventions on social properties, forms of taxation and an overarching political culture. Consequently, many social institutions such as marriage and gender adapted to the annual cropping pattern. For instance, because the *maresha* plough system required households to maintain a stable supply of oxen, seasonal labour mechanisms and gender divisions of labour changed and the cultural practice of *rist* emerged. *Rist* implies that if you don't farm a plot, other people can claim it as long as their ancestors can be traced back to that area. Most of these practices tend to reinforce hierarchical stratified relations between resource rich and resource poor farmers (ibid.). Furthermore, state influence at the local level was enacted through control over the assignment of patrimonies, channelling resources to the imperial court, and mobilisation and reallocation of local elites to create ties of loyalties. Some elements of these early state-farmer relations are still visible in the cultural practice of *dergo*, the habit to contribute food when highly esteemed visitors visit your community (ibid.). While the state played quite an important role in influencing the lives of the rural population in terms of social relations and taxes, the visibility of the state in terms of agricultural research and extension was rather limited (ibid.).

The imperial regime (1930-1974)

Haile Selassie, who became the Emperor of Ethiopia in 1930, is known for his achievement of successfully fighting the Italians, after their short lived occupation between 1935-1941 (Clapham 2018; Sbacchi 1979). Inspired by the modernisation agenda, Haile Selassie felt the need to demonstrate progress, and hence initiated several changes, also in relation to agriculture. Haile Selassie also adopted the 'Five year plans' in 1957 to give an impression of economic purpose. According to Clapham (2006), the five year plan is a classic example of the rhetoric of control, designed to give the impression that the state is in charge of things over which it actually has no power. In Ethiopia it seems that the first five year plans had little effect on the majority of the population: subsistence farmers in rural areas. The 1963-1968 plan was the first plan with a particular focus on agriculture. The priority was given to export and large scale commercial production, not smallholder agriculture. At that time, there were not more than 120 extension agents in the entire country (McCann 1995). Despite the export focus, 1967 saw the first large scale extension programme: the Comprehensive Package Programme. This programme had limited reach but it was the first programme that developed extension packages for farmers in Ethiopia (Berhane et al. 2018). Also the subsequent plan prioritised large scale mechanisation and export over smallholder agricultural productivity. One of the last acts of the emperor Haile Selassie was to initiate in 1971 – for the first time in Ethiopian history – a plan to invest in the small-farm sector, including investments in rural extension. This kick-started the first experimentation with chemical fertiliser. However only a fraction of the population was reached due to lack of funding (McCann 1995).

During the rule of Haile Selassie the basic institutional infrastructure for agricultural research and extension was established. In 1931 the first agricultural school was established: Ambo Agricultural School. This agricultural high school offered general education with major emphasis on agriculture (Kassa and Alemu 2016). Twelve years later the Ministry of Agriculture was founded, while the first research station opened its doors in 1954 in Bishoftu. In 1956 the Alamaya Imperial Ethiopian College of Agricultural and Mechanical Arts was opened, the first agricultural university of the country, which was initially responsible for the training of extension agents (Elias et al. 2016). The first extension department started in 1958 as one of the departments under the Ministry of Agriculture (McCann 1995). The

Institute of Agricultural Research (now called Ethiopian Institute of Agricultural Research, EIAR) was established in 1966, mandated with the responsibility for conducting agricultural research. This decision marked the beginning of a clear separation between the functions research (IAR), education (university) and extension (MoA), which were from now onwards formally divided over three independent administrative structures. This institutional divide has gone hand in hand with a weak collaboration among the three organisations, which, according to the majority of experts on this topic, continues to be one of the major weaknesses in the Ethiopian agricultural innovation system until today (Kassa and Alemu 2016).

Socialist rule: the Derg regime (1974-1991)

A major famine in 1974 contributed to a wide resistance among the population, culminating in a socialist revolution that removed emperor Haile Selassie from his throne. The 1974 revolution led to a sustained and systematic attempt to recreate the triumphs of communism. The nationalisation of all land (1975), followed by the establishment of state farms and agricultural producer cooperatives, were by far the most important measures introduced by the Ethiopian revolutionary regime (Clapham 2006; McCann 1995). Also private equity (e.g. tractors) was turned into state property (McCann 1995).

This period is also characterised by a rising gap between the realities and interests of urban elites (modernisation, state control) and rural populations (improved livelihoods, freedom). The socialist intelligentsia was predominantly urban and imposed its socialist ideology on the rural population (ibid.). A massive mobilisation campaign, accompanied by the establishment of an effective state apparatus including peasants associations (PAs) linked the central government to rural Ethiopians in a way that had never previously existed (Clapham 2018; McCann 1995). Farmers lost their social networks and were coerced to form new ones (cooperatives, PAs and linkages to the military regime). These new institutions restructured social and economic life as they were the mechanisms to ensure order: allocation of land, regulation of support, taxation and military conscription were arranged through these institutions (Clapham 2006).

Through the land act, the Derg regime reconfigured socio-spatial hierarchies that had prevailed in the country and tried to establish a relatively homogeneous smallholder agrarian order across the entire space of Ethiopia. However, Makkie (2012) argues that the land act also gave space to powerful elites to increase their control over the allocation of land and user rights. The increase of state control mainly took shape through large-scale villagization and resettlement projects, framed as highly modernist planning initiatives (Makki 2012). The new villages were based on the assumption that farmers only grow annual crops and had no space for animal husbandry (needed for ox ploughing), drying of animal dung, process grains, etc. At this point, farmers and extension agents started to resist the socialist regime (McCann 1995).

Revolutionary Democracy and the developmental state (1991 >)

After a few years of political unrest and civil war under the Derg regime, the Tigray Popular Liberation Front (TPLF) came to power in 1991, supported by the majority of rural smallholders (ibid.). In 1995 the government, consisting of predominantly members of TPLF, embraced ethnic-based federalism, with one national political party, the Ethiopian People's Revolutionary Democratic Front (Clapham 2018; Hagmann and Abbink 2011). Each federal region now had an ethnically based political party, such as the TPLF in Tigray for instance. With this governance model, ethnic-based identify was encouraged at the expense of national Ethiopian identity (ibid.). Moreover, this model ensured that formally, no group could be allowed to claim national political dominance. In this sense, the EPRDF tried to replace the perceived 'Amhara/ highland' dominated ethnocratic state with a multi-ethnic state (ibid.). However, it should be noted that the national party, EPRDF, has been heavily dominated by the Tigray-led TPLF (Clapham 2018).

The new rulers, who were trained in soviet revolutionary socialism, distanced themselves from liberal democracy. They embraced revolutionary democracy and declared 'democratic developmentalism' to be their informing ideological orientation (Clapham 2018; Makki 2012). From the start the EPRDF showed an unprecedented commitment to invest in smallholder agriculture. However, the EPRDF openly rejected the structural adjustments programmes and the macroeconomic policies promoted by international financial institutions, adopting alternative largely self-determined policies. According to Meles Zenawi (prime-minister until 2013), democratic developmentalism would make it possible to 'transform our political economy from one of pervasive rent-seeking to one that is conducive to value-creation' (Makki 2012).

2.3 Contemporary agricultural extension and decentralisation policies

What follows in this section is a summary of the major agricultural policies and programmes that the government of Ethiopia has implemented between 1991-2016.

Agricultural extension policies

The Agriculture Development-Led Industrialisation (ADLI) policy became the overarching strategy towards food security and poverty eradication in the 1990s. ADLI set in motion a series of reforms that sought to generate a more supportive macroeconomic framework, liberalise markets for agricultural products, and promote the intensification of food staple production through the use of modern inputs, especially seed and fertilizer packages (Spielman et al. 2012). The geographic focus was initially on the high potential highlands. An influential extension programme in this period was the Sasakawa Global 2000 project (SG-2000) (1993), funded by Japan, promoting the use of productivity-enhancing technologies by providing inputs and credit, and training using demonstration plots, supervised by researchers and development agents (DAs) (Elias et al. 2016). SG-2000 was the first project in Ethiopia to demonstrate that with sufficient inputs, supervision, and management, farmers could double or triple their yields of maize and wheat (Davis et al. 2010). In 1995, the EPRDF adopted the SG-2000 programme as its national agricultural extension system, referred to as the Participatory Demonstration and Training Extension System (PADETES) (Berhane et al. 2018). Between 1995-2000, the PADETES programme resulted in a massive increase in the number of farmers applying improved agricultural technologies, from 35,000 in the beginning to over 3.6 million in 2000 (more or less 35% of the farming population at that time) (Davis et al. 2010).

The years between 2001-2005 were less prosperous. First the national maize price crashed due to overproduction and later a drought hit the country with failed harvests and famines as result (Davis et al. 2010; Spielman et al. 2012). The government reacted with an increase in investment in the Technical and Vocational Education and Training programme (TVET) so that more extension agents could be trained (Davis et al. 2010). In 2002, the government also initiated its first Sustainable Poverty Reduction Strategy (SPRS) (Berhane et al. 2018). The main pillars of this plan were Agricultural Development Led Industrialization, civil service and justice system reform, governance, decentralisation and empowerment, capacity building (including education), and finally food security (Teshome 2006).

The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) (2006) was the successor of the first Sustainable Poverty Reduction Strategy. It was the first document outlining the government's ambition to become a middle-income country. Laid out as a five year plan it elaborated the country's vision on achieving the Millennium Development Goals and enhancing the (mostly agrarian) economic sector. It's focus was on agricultural productivity, enhancing agricultural industries, social justice and income increase. Decentralisation is a central theme in the entire document. Until 2005 the government was mostly engaged in studies on how to devolve power and authority to lower levels; limited actual devolvement had taken place, except in some cities (for instance Addis Ababa). In rural areas, the priority was to first build the capacity of local administrators in terms of handling more responsibilities (MoFED 2006, p.41). Contrary to the other reviewed policies, the rationale for decentralisation in PASDEP is mostly related to the efficiency argument. The PASDEP is the first document explicitly promoting the active involvement of citizens in local planning (MoFED 2006, p.185). It does however not contain details of how this will be organised.

The PASDEP was succeeded by two consecutive five year plans: Growth and Transformation Plan (GTP) I (2010-2015) and II (2016-2020). Under the grand scheme of GTP the Agricultural Growth Programme I was prepared by the Ministry of Agriculture, a five year programme aimed primarily at increasing agricultural productivity in a sustainable manner, enhancing market performance and facilitating value addition, targeting selected high potential areas, mainly in the highlands. One of the three general programming principles of the AGP I is decentralisation and bottom-up planning (the other two are comprehensiveness and value chain approach). Contrary to the PASDEP, decentralisation is mostly linked to the empowerment agenda. Decentralisation is oftentimes mentioned in the same sentence as bottom-up, demand-driven, participatory and equal participation of females: ‘Local male and female farmers, youth, women and private business enterprises are the owner of the program, and will actively participate in problem identification, planning, implementation and monitoring the activities.’ (MoANR 2010, p.9). In terms of extension delivery, the general idea in the document is that extension service should oversee that male and female farmers make progress in terms of agricultural productivity. This indicates that participating in the AGP I is thus not a voluntary exercise; active commitment from citizens is expected to contribute to the ambitions in the plan. The AGP implementation manual does not contain much details on how a decentralised approach would work out and what is being decentralised exactly (power, authority, budgets, etc).

AGP I is the first document that explicitly speaks about model farmers and development groups to support the promotion of agricultural technologies: *'[...] male and female farmers should be organized into development groups and undertake in depth discussion about innovations and best practices [...]'.* And later *'[...] Best practice identification will focus on proven technologies that have been implemented by model female and male farmers and showed successful results.' (MoANR, p. 35-36)*.

AGP II (2015) is the follow-up five year plan (aligned to GTP II). The focus on increasing agricultural productivity remains unchanged. While the term decentralisation is less central in the document, the policy contains much more details in terms of how the programme will be implemented, roles and responsibilities, and approaches used. This is also true for the way decentralisation is being implemented. For instance, it outlines the roles and responsibilities in local planning. Needs assessments are being done at the *Kebele* Ministry level[6], but plans are approved at the *Woreda* and finally regional level (MoANR 2015, p. 45). After approval, budgets will be transferred from federal to the lower administrative levels.

[6] *Kebele* level is the lowest administrative unit in the country.

Accountability is upward (from *Kebele* to *Woreda*, from *Woreda* to zone, etc) and based on annual targets. These targets are set at regional level and are in line with the national ambitions in terms of agricultural growth.

2

A new feature of AGP II is the establishment of *Kebele* Development Committee (KDC) and *Kebele* Planning Team (KPT), who are responsible for *Kebele* planning and implementation of *Kebele* annual plans. The role of the so-called development is made more explicit: *'... the leaders of the Development Groups are supposed to help facilitate the involvement of the farming community in the planning process through organising meetings where the purpose of AGP is explained to the community.'* (MoANR 2015, p.42). In AGP II, the government reflects on the inefficient input delivery so far, and outlines directions for decentralised organisation of input delivery (seed and fertiliser mainly) by initiating direct contracting mechanisms where possible (MoANR 2015, p.218).

The National Extension strategy (2015) was developed as reaction to the limited success of the extension system in achieving increased agricultural productivity. The Extension strategy confirms once more the commitment of the Ethiopian government in terms of investments in agriculture as main pillar of the economy. Like in AGP and PASDEP, decentralisation is a central organising principle (MoANR 2017, p.13). Even though the strategy stipulates that the current extension system is already well-structured and decentralised, it is acknowledged that the content of the extension messages is still rather top-down and there is limited space for context specific messages in the current extension practice (MoANR

2017, p.33). The strategy outlines the desire to contextualise extension messages.

Decentralisation

In the reviewed policies there is increasing attention for the involvement of citizens in local planning and needs-based extension services. Decentralisation is seen as key to achieve this. Explicit mechanisms are established that are supposed to enable decentralised planning, such as the Development Groups, model farmers, and Farmer Training Centres. These institutions are given a specific responsibility in mobilising farmers and involving community members in planning of agricultural activities as well as in the execution of them. Decentralisation thinking is thus trickling down to lower administrative levels, to the extent that it exceeds the *Kebele* level (which is the lowest administrative level in the country). Also in terms of procurement there is a significant policy shift, whereby procurement of inputs is clearly being decentralised from federal level to the lowest level possible (for smaller items this can be *Kebele* or *Woreda* level). However, approval of annual plans and budgets is still at regional level, and targets are set at this level too. This shows a potential tension between participatory planning and top-down targeting.

In Figure 6 a summary of the most important events in the recent agricultural history of Ethiopia are presented.

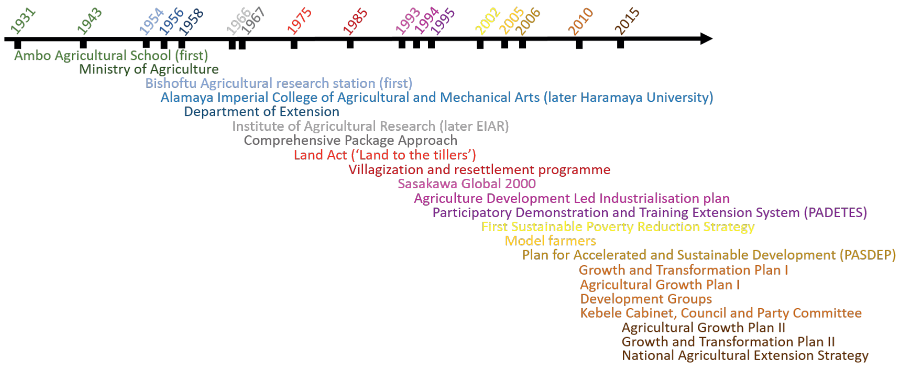

Figure 6 Timeline of important events in the agricultural history of Ethiopia
Source: the author

2.4 Review of extension modalities in practice

In this section the major modalities of agricultural extension delivery are presented: (1) Farmer Training Centres, (2) Development Agents, (3) model farmers, (4) development groups, (5) cooperatives and (6) credit services. I also pay attention to the identified tension between public and private service delivery because this came back in several publications as being important. In each sub-section I first present the data from the agricultural extension literature, followed by the review of sources from the political extension literature. Decentralisation is a red thread throughout the analysis.

Farmer Training Centres and Development Agents

Over the past two decades, the agricultural extension service has been decentralised to the *Woreda* and *Kebele* level; formulation of extension messages is still done at regional level. Currently, *Woreda* offices are staffed with subject matter specialists in the areas of agricultural communication, crops, livestock and natural resource management.

Agricultural extension literature

The agricultural extension literature provides a comprehensive picture of how DAs and FTCs have been operating and what have been the most important challenges. To deliver knowledge, the extension service makes use of individual visits by DAs to farmers' homes, group-based approaches, and mass media approaches including radio and print media. In some *woredas*, extension messages are transmitted at church/mosque gatherings during religious holidays or other occasional social gatherings (Berhane et al. 2018).

DAs are responsible for agricultural extension advice to farmers, including the organisation of field days, demonstrations and trainings in their sub-*Kebele* (ibid.). Ethiopia has the highest extension agent-to-farmer ratio in the world. In 2017, there were more than 72,000 DAs who reportedly served about 16.7 million smallholders. That is approximately one DA per 230 farmers (ibid.). Each *Kebele* is supposed to employ three DAs (crops, livestock and natural resource management) (Matouš et al. 2013).

Farmer Training Centres (FTCs) are an important vehicle to support extension at the local level (Elias et al. 2016). FTCs fit the decentralisation discourse, as they are close to the farmers. According to the Ministry of Agriculture there are 15,000 FTCs in the country (Berhane et al. 2018). Most of the times a FTC is comprised of a physical building with an office and a classroom, and a demonstration field where model technologies are demonstrated.

FTCs are managed at the *Kebele* level, but funding for capital, operational, and salary costs come from the *Woreda* level. An extensive review of the national extension system by Davis and others (2010) showed that, in 2010, approximately 30% of the FTCs are operational (Davis et al. 2010).

The most often mentioned challenge among the agricultural extension literature is the limited capacity of DAs and FTCs in terms of basic infrastructure and facilities, skills and funding (Berhane et al. 2018; Davis et al. 2010; Elias et al. 2016; Spielman et al. 2012). Although agricultural extension was decentralised to the administrative control of regional governments and *Woreda* administrations, another widely recognised limitation of the contemporary extension system is its supply-driven nature and the continued imposition of quotas and targets from above (Spielman et al. 2012). DAs and FTCs are not accountable to farmers, but to their superiors who are also accountable to higher administrative levels (Davis et al. 2010). Another major problem often mentioned by the agricultural extension literature is the involvement of extension workers in non-extension activities such as tax collection, fertiliser distribution and loan repayments. According to most literature, this leads to the undermining of their credibility and reputation as neutral advisors (Berhane et al. 2018; Davis et al. 2010).

Political extension literature

The political extension literature emphasises the powerful position of DAs, who operate at the interface between the world of farmers and the world of (local) authorities. Hierarchically, DAs are situated at the lowest ranks of their organisation. On the other hand, they are the first and foremost contact for local communities when it comes to agriculture. In an in-depth nationally representative study about decentralisation and extension in Ethiopia, Planel (2017) postulates that this mediating position renders DAs into a powerful vehicle for the national government to extend their influence. The administrative reorganisation of the *Kebele* in 2011/2012 is in line with this idea. In each *Kebele*, there are now three structures: an elected Council, an appointed Cabinet, and an appointed party Committee. The Cabinet is accountable to the Council (MoANR 2015). Appointed by the state and taking part in the Cabinet, DAs are neither elected nor removable by local councils. According to Poulton and Berhanu (2014), the vast majority of council and committee members are member of the party and there is significant overlap in membership; they argue that this structure increases the likelihood that DAs are involved in decision-making that concerns party interests.

Model farmers and development groups

In addition to FTCs and DAs, the Ministry of Agriculture and Natural Resources (MoANR) has put in place a model farmers approach, mainly to reduce the workload of DAs. The idea is that DAs transfer knowledge to model farmers, and model farmers take up the responsibility of the daily information transfer to other farmers (Berhane et al. 2018). The work with model farmers started already around 2005, but became visible in policy documents from 2010 onwards.

From 2008 onwards, a new chapter was added to the decentralised extension delivery approach: farmer development groups were created. Each development group, consisting of 20-30 farmers, has sub-development groups organised with five members, led by a model farmer (otherwise known as 1-5 groups or syndicate).

2

Agricultural extension literature

There is no official publicly available document that sets out the official, national line and rationale behind model farmers. However, most agricultural extension literature sources agree that model farmers must respect two principal lines of conduct; they must be 1) 'strong' (socio-economic) referring to the ability of gaining wealth, working hard, learning new technologies, and putting them into practice, and 2) 'community leaders' (leadership). Model farmers must set an example: sending children to school, keeping an orderly house, following rules of hygiene, taking part in traditional self-help organisations, helping to solve disputes.

The agricultural extension literature mainly puts forward the efficiency gains that the model farmer and development groups are supposed to bring about. Model farmers are expected to demonstrate improved technologies and best practices to the wider community and create a more effective learning process among farmers through group settings. The sub-development groups are expected to meet periodically to discuss key extension messages. Rather than one-to-one meetings with each farmer, the DA subsequently focuses his or her attention to the model farmers and group leaders only (Berhane et al. 2018). The results from a large survey among DAs show that indeed community and development group meetings were more prominent than other approaches in extension (ibid.).

Political extension literature

The political extension literature points to a number of negative effects of the establishment of model farmers and development groups. Before we discuss these, we first present a brief historical background to enable a better understanding of the political nature of the notion of model farmers. With the 1975 land reform act, 'Land to the tillers', land from the rich urban elite was redistributed to landless rural youth (section 2.2). This young generation, who benefited most from the reforms during the Derg regime, was called *birokrasi* (from bureaucracy) (Adem 2012). When EPRDF came to power in 1991, the *birokrasi* was completely banished. The incoming regime established a new category of local administrators, again poor young landless farmers (Lefort 2012). Hoping to increase agricultural production and productivity, the EPRDF launched an intensive agricultural campaign (PADETES) which imposed annual quota targets on each of the region's administrative zones, *Woredas* and *Kebeles*. The quota received strong support from a group of ambitious young men and women who envisioned better chances for themselves if they supported party initiatives. By contrast, heads of well-established households (the former *birokrasi*) worried that the technology packages might not work as promised. They also worried about a return to the much discredited top-down campaign approach, which brought back memories of the failed socialist approaches and forced resettlement projects of the previous regime (Adem 2012).

A common observation among the political extension literature is the presence of imposed targets and its effect on the selection of extension beneficiaries. DAs and local authorities feel a pressure to meet adoption and productivity targets, which are set at national level and divided over regions, zones and *Woredas*. This apparently drives DAs to focus on wealthier farmers who are more likely to be of support in achieving these targets, at the expense of poor and/or female farmers (Emmenegger 2016; Lefort 2012; Planel 2017).

Secondly, instead of creating a safe learning environment, most political extension literature tends to write about model farmers and development groups as a means to incorporate farmers into structures of control (Adem 2012; Lefort 2012; Planel 2017; Segers et al. 2009). In 2005 the ruling EPRDF started the recruitment of model farmers. This recruitment was, according to Lefort (2012) first and foremost an attempt to deprive the opposition of its rural base and to gradually win the interests of the rural elite. Model farmers automatically became members of the party, and vice versa. In exchange for their support (or political neutrality), the regime promised to open the way to their economic prosperity, by reserving for them the exclusive support of the authorities (Lefort 2012).

In Oromiya, additional to the development group, the local government created the *garee* (team) level, linking households to the lower tiers of the decentralised system. The *garee* is widely contested as it is argued that they are deployed as mechanisms of control and repression at the household level (Emmenegger 2016; Lefort 2012).

Most farmers do not seem to be ignorant of the political meaning of development groups and model farmers; they interpret these new institutions as a revival of local *encadrement* from the socialist Derg regime (Emmenegger 2016; Lefort 2012; Planel 2017). Political extension literature emphasised that, despite efforts from the government to mobilise the 1-5 or development groups for collective labour needed for improved agronomic practices (e.g. ploughing, row planting, etc), farmers preferred to stick to their own traditional organisations, based on their own social or clan-based preferences and not government initiated (Emmenegger 2016; Planel 2017).

Tigray is somewhat exceptional, where farmers are generally more cooperative towards the idea of development groups, which are post-revolutionary versions of the groups of about 30 neighbouring households set up by the TPLF to mobilise the population in liberated areas. To date sub-district authorities make use of them to convey messages to farmers and coordinate farmers' labour contributions to collective soil and water conservation. Government groups are also used for the transfer of technologies. However, in an in-depth study on the entanglement of agricultural extension and politics by Segers (2009) in Tigray, a certain level of *encadrement* was observed as well, mainly through a translation of discourses of the war against the socialist Derg regime to the contemporary 'struggle against poverty'. At the administrative level, farmers were encouraged to join the programme and local authorities pointed to the negative consequences if farmers were not willing. At the discursive level, mobilisation campaigns were laced with words like *lemat serawit* (development army), *tsere-dehenet tegel* (anti-poverty struggle) and *lemat arbegna* (development patriots). This war vocabulary was used to encourage citizens to participate in extension programmes and campaigns. Moreover, institutions which were previously used to give voice to local populations to express their needs, were now used to reduce space for public opposition by implying that those who are unwilling to join the movement are deserting or disloyal (Segers et al. 2009).

2

Cooperatives and credit services

Partly to lighten the heavy burden of DAs, the start of GTP I and AGP I, marked a shift in responsibilities for input supply from DAs to cooperatives. The EPRDF was eager to revitalise cooperatives, which had collapsed under the socialist regime. In the beginning of EPRDF rule their main function was to distribute farm inputs, but from 2006 onwards cooperatives became an instrument for the execution of the government's plan to enhance smallholder commercialisation as part of agricultural extension delivery to promote modern agricultural technologies. Additionally, the marketing function and link to finance also became more important for cooperatives and unions (Abebaw and Haile 2013; Spielman et al. 2012; Tefera et al. 2017). Currently, cooperatives are organised in primary cooperatives at *Kebele* level, which are united in cooperative unions at woreda level.

Agricultural extension literature

The fact that Ethiopia has never been colonised is often mentioned by the agricultural extension literature as one of the reasons why Ethiopia lacks an (albeit imposed) tradition of farmer-based organisations (Davis et al. 2010). While cooperatives had been established by previous rulers during the imperial and the socialist Derg regime (Abebaw and Haile 2013), most cooperatives had collapsed by 1990, leaving behind a bitter taste of complete failure in terms of imposed collective action. According to Davis and her colleagues, these negative experiences with cooperatives under the previous regimes caused a general feeling of distrust among most farmers with respect to cooperatives (Davis et al. 2010). However, Abebaw and Haile (2013) stress the independent character of cooperatives and their supportive function in promoting access to modern inputs (Abebaw and Haile 2013).

The agricultural extension literature furthermore emphasised that while agricultural policies highlighted the importance of commercialisation, on the ground, the focus of cooperatives remained on input distribution, as demonstrated in a paper on the role of supporting institutions in agricultural productivity in Ethiopia (see Gebremedhin et al. 2009). In 2006, the share of cooperatives in supplying inputs was about 70 per cent while their share in output marketing was only 10 per cent (Tefera et al. 2017).

Further, the agricultural extension literature mentions that, despite the discourse of decentralisation and bottom-up planning, the planning of cooperative development remains rather centralised. Federal targets are being imposed on regions and *Woreda*s, for instance in terms of number of new unions to be established (*Woreda* level) and increases in membership (*Kebele* level) (Abebaw and Haile 2013; Tefera et al. 2017).

Credit is an underreported topic in the agricultural extension literature, in contrast to the political extension literature, as will become clear below.

Political extension literature

The political extension literature links the revitalisation of cooperatives to the beforementioned *encadrement*. Channelling seed and fertiliser distribution through cooperatives makes cooperatives an important player in the modernisation agenda (Berhanu and Poulton 2014). The majority of political extension literature reports that farmers are coerced to use fertiliser. *Kebele* administrations are under pressure to meet their targets, not only in terms of increases of numbers of farmers who apply fertiliser but also in terms of the amounts that farmers are supposed to apply per crop. According to Planel (2017), in order to meet these targets, DAs therefore enrolled farmers in fertiliser schemes, regardless of their real needs or ability to pay for fertilisers. Moreover, most farmers have do not have enough money to purchase fertilisers in any case and thus have to take a loan. The vast majority does not know they pay interest or how much (ibid.). The amount of input credit available to farmers has been reduced as compared to earlier years. At best, farmers have to pay half the value of the package up front ('half credit') (ibid.).

Public control versus privatisation

Besides the key modalities used for agricultural extension delivery, the two bodies of literature also reported on the balance between public and private service delivery. On this topic both bodies of literature were critical towards the public bias in service delivery. However, the arguments brought forward by each body of literature is different in nature. Below the main points of critique are discussed.

Unlike many other African governments, the Ethiopian government has always retained a high level of control over its economic policies and major sectors such as the seed and fertiliser sector, rural finance, cooperatives, land and extension delivery (Berhanu and Poulton 2014). The agricultural extension literature stresses the negative effects of this political choice on the effectiveness of the seed and fertiliser sector. For instance, Spielman and his colleagues report that while the fertiliser sector was once open to private companies, the share of private fertiliser firms operating in the market went from 33 percent in 1995 to zero in 1999. These firms were replaced by 'private holding companies' with strong ties to government and since 2007 fertiliser imports have been controlled by the state-enterprise AISE (Agricultural Input Supply enterprise) and cooperative unions (Spielman et al. 2012). Spielman and his colleagues further note that the strong influence of the state in the seed, fertiliser and micro-finance sectors hampers the development of a vibrant input market.

The political extension literature links the public bias in agricultural service delivery to the developmental state ideology of the EPRDF, which implies a strong commitment to state-party leadership over the development process (Berhanu and Poulton 2014; Clapham 2018). Clapham argues that the government's aversion to so-called 'rent-seeking' is paradoxical, given the government's own efficiency and success in appropriating rents and retaining control of enterprises and resources that the state seeks to use to promote its own development agenda (Clapham 2018).

While the fertiliser and seed sector remain strictly controlled (Berhanu and Poulton 2014), the state has showed shown more flexibility in terms of privatisation in other domains, most notably in land policies and the promotion of small and medium enterprises (Makki 2012). According to Teshome (2006), it is likely that this shift towards privatisation has been caused by pressure of international donor community (Teshome 2006). The negative consequences of the shift toward privatisation in terms of land tenure have been described elsewhere (Chinigò 2015; Hindeya 2018; Lavers 2012; Moreda 2017) but are beyond the scope of this chapter.

2.5 Effects of investments in agricultural extension

In this section the effects of the investments in agricultural extension, according to the agricultural extension literature and political extension literature, are discussed. I start with the effects put forward by the agricultural extension literature, followed by the results that were emphasised by the political extension literature.

Agricultural extension literature

The agricultural extension literature stresses the increase in agricultural productivity as a major result of the investments in agricultural extension. Ethiopia has witnessed a significant increase in agricultural productivity over the past years. On average, between 2004-2014, crop output represented 32% of real GDP and grew at an annual rate of 8.8% (Bachewe et al. 2018). Recent evidence suggests that this increase is mainly associated with expansion in cultivated area of land and labour productivity, but also partly due to increased use of chemical fertilisers (ibid.). According to Gebremedhin (2009), participation in the extension programme increases the probability of fertiliser use by about 17% and by approximately 12 kg/ha (Gebremedhin et al. 2009). A large and recent review study of Berhane et al. (2018) also reports that farmers who have access to extension are more likely to apply modern inputs. This study also shows that the vast majority of farmers (with access to extension services) is satisfied with the extension service they receive, while another study shows that approximately 55% of the farmers (with access to extension services) is satisfied (Elias et al. 2016). These positive effects can - at least partly – be explained by the massive investments in agricultural extension of the Ethiopian government. As such, the extension system and its approaches (model farmers, FTCs, package approach) can be regarded as successful.

Besides these successes, the agricultural extension literature also points to certain persistent challenges, framed as capacity challenges at several levels. For instance, an often mentioned constraint is the actual infrastructure and resource levels in most FTCs, the limited numbers of DAs as compared to their workload, and their inadequate training (Bachewe et al. 2018; Berhane et al. 2018; Davis et al. 2010; Spielman et al. 2012). A large review of the public extension system, conducted by Davis et al. (2010) found that the technically-oriented training and reward system of DAs results in poorly motivated extension workers with an overall technical 'technology push' mind-set and limited flexibility to tailor to the needs of (mostly smallholder) farmers (Davis et al. 2010). The same review also found that DAs mainly promote fertiliser use, row planting and new varieties for the three major cereals (maize, wheat and teff). Furthermore, Berhane et al (2018) found that the extension system seems to be narrowly focused on the push for fertiliser, and less effective in (more complex) agronomic advice linking farmers to markets. Furthermore, Gebrehiwot and van der Veen (2014) found that despite the investments and improvements in the agricultural extension services, nutrition insecurity and poverty remain persistent challenges.

Political extension literature

The political extension literature sketches a rather different picture when it comes to the results of the massive investments in agricultural extension of the past decades. Rather than emphasising the effects on agricultural productivity, or writing about capacity problems, this literature stresses that decentralisation proved a useful vehicle for the state to extend its authority and control to the lowest level possible (household). The literature points to intended and unintended effects of this process in relation to social exclusion and marginalisation. In the section below these effects are described in more detail.

<u>*Local elite: economic rewards in return for loyalty*</u>

A commonly heard critique is that the creation of model farmers created a local elite which is closely entangled with local politics and not so much related to farming as such. In Tigray for instance, the local party leadership motivated TPLF members to be model farmers, but more importantly, invited successful (model) farmers to join the TPLF. Conversely, according to Segers (2009), model farmers adopted a new technology irrespective of its technical characteristics. Showing interest in development programmes proved to be an effective way for politically ambitious farmers to secure farmer representative positions in the future (ibid.). In Amhara, between 1995-2000, the first group of farmers who ‘volunteered’ to adopt the packages were ambitious youth who envisioned opportunities for upward social and political mobility by cultivating patron-client ties with party functionaries. By adopting the packages, these young farmers sought to score political gains in the form of party-appointed salaried jobs and access to government-controlled resources such as land, food aid, and cash (Adem 2012). According to Lefort (2012) this pattern continued in the period 2005-2010. The rural elite, who was rather critical at first (until 2005), was turned into vanguards and later on became advocates of the government (Lefort 2012).

The common thread throughout the political extension literature are mechanisms of reciprocity, loyalty and upward mobility. In need of support to meet targets, local authorities turn farmers into model farmers and party members, and reward them with social, economic or political opportunities in return for their support (or neutrality). These mechanisms sustain the creation and recreation of a local elite whose success depends not so much on a talent for agricultural cultivation, but rather on mastering a wide variety of political skills, including loyalty to superiors, and cultivating instrumental ties with local government agents responsible for redistributing resources. These mechanisms can be found across geographical areas and time. While the notion of model farmers is relatively new, the underlying mechanisms were already present in earlier regimes (Adem 2012).

Further marginalisation of the poor

The other side of the coin is the observation of a process of further marginalisation of already poor smallholders. *Economically*, the push for chemical fertilisers and market integration is argued to impose subsistence farmers to unnecessary risks, increasing their vulnerability and pushing them further down into the cycle of poverty (Emmenegger 2016; Makki 2012; Planel 2017). Taking into account the contested return on investment of fertiliser in some contexts (Planel 2017), it seems a significant risk that farmers are requested to take by their government, in particular if they have to take a loan with interest. Defaulting smallholders were reported to be forced to sell their oxen and other assets to settle their debts, further marginalising the livelihood options for these smallholders (Makki 2012; Planel 2017). In line with this, Makki (2012) argues that the integration of Ethiopian farmers into the corporate food system subjects smallholders to global competition, where previously customary and non-monetary social arrangements had prevailed. Subsistence farmers who normally don't sell their produce on the market are vulnerable to the risk of not having enough food throughout the year.

Next to economic effects, the political extension literature also points to *social* effects of the push for market integration and fertiliser use. While the better off are included by the extension system and rewarded for their performance, farmers who are not able or willing to adopt fertilisers and the subscribed crops and varieties are put in a negative light. Non-participation is taken as a sign of resistance and treated similarly to wartime dissidence (Adem 2012; Planel 2017; Segers et al. 2009). This was also emphasised by Lochrane and Tamiru in their study on the translation of the Productive Safety Net policy into daily practice of agricultural extension, where they argued that 'voluntary' participation must be understood as occurring in the highly politicised environment within which it takes place, wherein refusal is equated with political opposition, resulting in exclusion from benefits (Cochrane and Tamiru 2016). Poor farmers, who do not adopt introduced technologies, are often disputed in the community and have a low social status (de Roo et al. 2019). This negative image results in social exclusion in terms of social networks needed to access productive resources like oxen and labour. This process of social exclusion among farmers is most prominently visible during the weeks preceding the first soil preparation, a period of great interdependence between farmers as they make arrangements for share-cropping (e.g. oxen sharing, labour sharing, land sharing). To borrow oxen and to engage in labour sharing, one needs to possess a certain status, a certain social respectability. Farmers with a low social status (i.e. being poor, being perceived as 'lazy', being a dissenter, but also females in many cases), are low on the list for these social arrangements and thus often excluded from the means to properly prepare their land (Planel 2017). It is difficult for farmers to escape this vicious circle of social exclusion and economic vulnerability.

Farmer's coping strategies

Farmers have developed several coping strategies to deal with local authorities that aim to exert influence on their daily lives. On the one hand, the strategy is to avoid dependence on (unreliable) rulers. As a result, farmers have become skilled in keeping the *mengist* (rulers) at a distance. Subsistence farmers may opt for strategies to avoid the compulsory fertilisers by shifting to cash crops (notably chat) or livestock production. Another strategy is to forge reciprocal ties with local powerful elites or rulers. An important element of this strategy is showing loyalty to local rulers. The example of model farmers who support local authorities in their efforts is a good example of this strategy. However, an important consequence of being loyal is that opposing the government and its ideas is not an option. In line with this, Adem (2012) argues that cultural codes of masculinity suggest that a ruler must defend his honour by enforcing obedience. Malara and Boylston complement this argument by postulating that orthodox Ethiopians perceive top-down power relations as a fact of life (Malara and Boylston 2016). The duration of this contract (between ruler and ruled) depends on the calculated self-interest in terms of real or imagined economic benefits and personal security. The subordinate may cease to obey when these calculated expectations are not met. The tension between these two extremes closes other options for expressing dissent (Adem 2012).

2

2.6 Comparison between two bodies of literature

Taking decentralisation as point of departure, two bodies of literature were compared in terms of what they report on the modalities and effects of agricultural extension in Ethiopia: agricultural extension literature and political extension literature. The differences between the two bodies of literature are summarised in Table 4.

Table 4 Summary of findings two bodies of literature

	Agriculture extension literature	*Political extension literature*
	Knowledge and information exchange	
FTCs and DAs	Under-resourced (FTCs and DAs) Limited capacity (DAs) DAs overstretched, underpaid, and used for tax collection and other administrative duties DAs focus on fertiliser promotion, less on knowledge transfer.	FTCs not mentioned. Administrative restructuring increases the influence of party politics at Kebele level At the interface between farmers and authorities, DAs are a powerful vehicle for increased state control Imposed productivity targets put pressure on DAs and local authorities to enrol farmers in fertiliser programmes.
Model farmers and development groups	Create favourable learning environment (MF) Reduce workload of DAs (MF)	Model farmers are a continuation from past government efforts to secure support among the rural population

	Influential mechanism to transfer knowledge (DG).	*Encadrement:* MF and DG as political tools to secure and extend state power/control Coercion to participate, to use fertilisers, to produce for the market Farmers reinforce the status quo by supporting local authorities (expecting favours in return) War narrative of poverty as the enemy reduces the space for public dissent.
	Input and output markets	
Private/public	State monopoly hampers seed, fertiliser and credit markets; Public system not able to meet the increasing demand More farmers apply modern seed varieties, inorganic fertiliser and modern agronomic practices. This increases agricultural productivity of the country.	Narrative of rent-seeking and developmental state is used to legitimise monopolisation of crucial sectors State is inflexible in input sector but opportunistic in privatisation of land. Market orientation is part of the neo-liberal modernisation agenda and increases smallholder farmers' vulnerability.
Cooperatives and credit	Cooperatives are effective in input distribution, less so in marketing Cooperatives have limited experience and capacity in cooperative management Negative previous experiences impede farmers' confidence in cooperatives.	Parastatal cooperatives and credit facilities are used to coerce the use of modern inputs. Farmers become more dependent on the government and have less choice what they grow and how.
	Effects of investments in agricultural extension	
Achievements	Increase in agricultural productivity Participation in the extension programme increases use of fertiliser	Not emphasised
Challenges	Capacity, resource and infrastructural constraints limit effectiveness of agricultural extension Extension system focuses too narrowly on fertiliser promotion	Decentralisation discourse is used to extend state control Mechanisms of reciprocity, loyalty and upward mobility sustain the creation and recreation of a local elite Further marginalisation of already poor smallholders Farmers developed coping strategies to deal with local authorities (avoid dependence and forge reciprocal ties)

The agricultural extension literature mainly points to technical (and a-political) challenges such as the lack of capacity and resources to provide effective extension services. On the contrary, the political extension literature sketches a picture of how agricultural extension practices contribute to further marginalisation of already poor and vulnerable farmers, and the reinforcing nature of the dependence between local authorities and farmers.

A similarity in the two bodies of literature is their critique on the strong public dominance of the agricultural extension system (including the organisation of input delivery). While the agricultural extension literature stresses the negative economic effects of this public dominance in the seed and fertiliser sectors, the political extension literature puts more emphasises on the social effects by pointing out how the arm of the state impacts on farmers' social lives and planting decisions in particular.

2.7 Discussion

Complementarities between bodies of literature

Putting these two streams next to each other, a more comprehensive picture emerges of how agricultural extension policies and practices have taken place in the past decades. It is remarkable that the agricultural extension literature turns a blind eye towards the entanglement of politics with agricultural policies and extension practices, because a closer look with a political lens reveals unmistakably that this entanglement has been an influential factor in policies and daily practice of agricultural extension on the ground. A risk in this regard is that agricultural extension literature uncritically seems to rely on large data-sets collected by government agencies. Given the politicised nature of the extension system and the pressure to perform, one could argue that these data-sets may have several biases. Biases do exist, mainly in terms of how data is collected and sample selection. For instance, studies about the satisfaction of farmers with extension services only sampled farmers who actually have access to the extension service (see sample procedure in (Bachewe et al. 2018; Elias et al. 2016) for instance). The study of Cochrane and Tamiru was the only study which explicitly addressed the socially desirability of farmers in their responses and they explicitly mentioned strategies to overcome this type of bias (Cochrane and Tamiru 2016). Complementary (or otherwise independent) data would be a valuable addition.

On the other hand, the political extension literature may be overly critical, preventing them to see how the massive investments in agricultural extension have started to bear fruit in terms of economic development and nutrition security in the country. Furthermore, it has to be noted here that a common characteristic of the political extension literature is its tendentious and suggestive nature. Most sources are qualitative and based on anecdotal evidence. This makes it difficult to assess the external validity of the data beyond the villages where the data was collected for the various peer-reviewed articles that were analysed in this chapter. However, the obvious similarity among the different accounts across geographic areas seems to suggest a common pattern of entanglement of politics and agricultural extension at the least.

2

Historical continuities in change

The political extension literature places the contemporary extension discourses in a larger pattern of historical relations between the strong authoritarian state and its citizens and mainly describes its negative effects. The majority of this body of literature understands the politicised nature of the work of DAs, model farmers and development groups as a historical continuation of the exploitative power relations between dominators and dominated, command and subordination, and, at least for the past centuries, between exploiters and exploited. Placing the current practices in a wider time frame sheds a light on some of the underlying mechanisms that inhibit the system from changing. For instance, a red thread throughout the authoritarian Ethiopian history is the way authorities have cultivated feudal relationships with citizens and local elites, incentivising rent-seeking rather than high agricultural productivity. The Derg regime is a good example of strong state control and attempts to reorganise local life, for instance through the massive resettlements and villagizations which restructured local social arrangements. Another red thread is the continuous shifts in power and consequent reversions in terms of beneficiaries of governments and those who are excluded or lose valuable assets. For instance, with the 'land to the tillers' act, the Derg regime reversed land ownership from a mostly urban elite to a rural deprived group of landless farmers. A similar reversion took place when the current ruling party EPRDF took the power, when landless young farmers were given the opportunity to receive land and other support to start a new life, in turn for support of the new government.

According to the political extension literature, the lived experiences of the rural population have resulted in a broad base of inherently opportunistic citizens who have cultivated coping strategies to deal with the far-reaching influence of the state and its agents. These strategies include keeping the government at a distance and/or forging strategic ties with local authorities through showing loyalty. An important implication of the second strategy is that the space for public dissent is practically non-existent. Farmers can either suppress dissent entirely by engaging in outright rebellion, or express dissent in devious ways, including the subtle strategies that James Scott called 'weapons of the weak' (Scott 1985). These devious ways of resistance have indeed been described by some of the political extension literature, for instance by Planel (2017) who states that many of the poor see themselves forced to clothe their resistance in the public language of conformity and Cochrane and Tamiru (2016) who describe the challenges of socially desirable behaviour of respondents in their study. This situation contributes to a perpetuation of the status quo and limits the space for change from bottom-up as farmers are unlikely to openly propose alternatives or critique ideas coming from the *mengist.*

Placing this research in a wider context

This study on the political dimensions of the Ethiopian agricultural extension system is a contribution to a small body of literature on the role of politics in agricultural extension delivery. In some ways Ethiopia is not unique. In many low income countries where budgets are limited, ruling elites must consider ways to maintain the support of powerful groups and individuals, and one way to do this is through public programmes (Khan 2010), such as extension services. Linking advisory services to tangible inputs such as fertiliser and seed is known to be an effective means to create a broad base of support among smallholders (Poulton 2014). In this line, the strategy of EPRDF that upfront investments in agricultural development would be a means to create a robust middle class of smallholder farmers which would serve as reliable constituency is widely observed (ibid.). Furthermore, other scholars in this domain have argued that worldwide, the effectiveness of agricultural extension delivery is heavily dependent on political will and politics in general (Anderson and Feder 2004). One of the few well-studied empirical cases is the implementation of the National Agricultural Advisory Service (NAADS) in Uganda. Because the Ministry of Agriculture was largely excluded during the design of the programme, actors within the Ministry successfully boycotted the reforms, which eventually resulted in a major failure of the programme (Rwamigisa et al. 2017). Others pointed to the importance of relations of patronage among politicians and local elites during the implementation of the extension reforms in Uganda, where local elites were able to capture extension resources in return for support to the 'anti-reform camp', which eventually contributed significantly to the failure of the reforms (Kjær and Joughin 2019). More generally Booth and Therkildsen argue that in clientelist settings, which are common across Africa, a high level of competition tends to reinforce incentives to use public programmes for political support (Booth and Therkildsen 2012). These parallels show once again that political factors are of major importance and taking these factors in account in AR4D programme design, implementation and evaluation would make these programmes and their objectives more realistic.

Despite certain parallels that could be drawn between Ethiopia and other countries in Africa, the fact that Ethiopia has not been colonised in combination with the particular authoritarian history and the engrained reciprocal relations between local rulers and farmers, make Ethiopia a unique case (Clapham 2018). The findings of this case are therefore very specific and difficult to extrapolate to other contexts. Given the limited attention to politics in agricultural extension, and the importance of it (as shown in this chapter), it seems relevant to further explore this topic empirically in other countries.

Separate communities; conflicting ideologies?

One could argue that it is slightly artificial to treat the two bodies of literature as entirely separate, since they partly originated from the same key word search. However, the two bodies of literature seem to represent two different communities which hardly communicate with each other. For instance, while the agricultural extension literature publishes mainly in journals such as Agricultural Economics, Food Policy and World Development, the political extension literature on the other hand is widely represented in journals such as the Journal of Peasant Studies, African Studies Review and Third World Quarterly. Only in one of the journals both bodies of literature were represented: the Journal of International Development.

This literature review reveals a deeper divide, namely the existence of two quite deviating underlying ideologies about the type of change that is needed and how change happens or should happen. The political extension literature frequently referred to fertiliser and commercialisation policies as a push into the neo-liberal market system. This is part of a broader negative attitude towards modernisation, commercialisation, market capitalism, and neo-liberalism among a wider group of scholars within the community of Political Ecology. The agriculture extension literature could be positioned at the other end of this continuum, implicitly (and sometimes also explicitly) advocating the modernisation project, including its preference for external input-driven agriculture and a push towards global market integration of smallholder agriculture.

Conclusions

This literature review has shown that two bodies of literature co-exist which emphasise two different but complementary sides of the agricultural extension system in Ethiopia. The agricultural extension literature emphasises the investments in and achievements of the agricultural extension service and points to the impressive progress made in the past decades in terms of number of extension agents, FTCs, the expanded reach of the services and the positive and significant role played by DAs in promoting fertiliser and high yielding varieties. This body of literature frames the challenges facing the agricultural extension service in a-political terms such as 'lack of resources, infrastructure and capacities'. Political and historical factors are mostly ignored in this literature; except for the strong role of the state in seed and fertiliser provision and the role of DAs in non-extension related tasks (such as tax collection). This literature review has also brought to the foreground an often ignored perspective on the Ethiopian agricultural extension system: the political extension literature. This body of literature argues that the agricultural extension system has been shaped by social, political and historical factors which continue to influence the modalities of agricultural extension delivery. This literature showed that changes in agricultural extension policies and discourses should not be analysed in isolation from historically shaped hierarchical relations between authorities and citizens, which over time have left practically no room for public dissent. These historical relations have implications for how fashionable terms such as decentralisation, participation and empowerment find their way into old and new extension modalities, such as model farmers, development groups and the powerful positions of extension agents. In line with this, and important for the rest of this thesis is the observation of the political extension literature that the agricultural extension system seems to contribute to the further marginalisation of farmers who are not willing or able to shift to commercially oriented agriculture, which largely relies on external inputs and markets.

Acknowledging the importance of both bodies of literature, the last conclusion that can be drawn based on this literature review is that these two bodies of literature seem to co-exist in two parallel worlds, adhering to different ideologies about the type of change that is desired and how change should happen. This is a pity because the two bodies of literature have complementary insights which are both important to advance agricultural extension policies and practices in Ethiopia and beyond.

Chapter 3

On-farm Trials for Development Impact? The Organisation of Research and the Scaling of Agricultural Technologies

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Abstract

Changes in donor priorities have meant that agronomists working in the tropics find themselves in a fundamentally new operational space, one that demands rapid improvements in farmers' livelihoods resulting from the large scale adoption of new technologies and crop management practices. As a result, on-farm trials in contemporary Agricultural Research for Development (AR4D) are increasingly implemented both to collect data and to spur farmer adoption, often with the goal of reaching large numbers of farmers. We examine the different interpretations and organisational practices of AR4D organisations in this new operational space, and reflect on the usefulness of on-farm trials for agricultural technology scaling. Three case studies are presented to address these questions – two in sub-Saharan Africa and one in South Asia. Each study is considered in light of Science and Technology Studies theory and locates science as a politically situated practice, recognising the tension that scientists face between providing evidence and persuading selected audiences. The first case study in southern Africa shows the tension between researcher-controlled experimentation and the need to collaborate with partners to demonstrate technologies for wide scale adoption. Geared towards the scaling of new technologies, the location and design of these demonstration-trials restricts their outreach and potential development impact. A second case study analyses the organisation of on-farm trials in an AR4D project in Ethiopia. Using a sequence of different on-farm trials as steps of a scaling strategy, the AR4D collaborators in this multi-partner project have different interpretations of the purpose of the trials, which farmers should implement them, and what data should be collected to support scaling. As a result, several biases are introduced that appear to reduce the external validity of the trial outcomes, thereby limiting their potential to guide extension and scaling efforts. A third case study in Bangladesh describes how research and development organisations often work with the same farmer-beneficiaries, though with considerably different farmer collaboration modalities. This complicates farmers' motivations for engagement in adaptive- and demonstration-trials, with ramifications for the validity of experimental results and adoption metrics. We conclude by discussing how the contemporary political and institutional environment of AR4D produces project beneficiaries and research outcomes on selected farms, but not necessarily impacts at scale.

3

Keywords: Scaling, on-farm experiment, science and technology studies, adoption, development oriented agronomy

3.1 Introduction

Over the past decades, the context of Agricultural Research for Development (AR4D) has changed considerably. The rise of the participation agenda, increasing private sector influence, philantrocapitalism, and a growing donor focus on generating large scale farmer impact has significantly influenced the nature of research funding (Sumberg and Thompson 2012). AR4D organisations are encouraged to demonstrate impact at scale, preferably as quickly and efficiently as possible (Glover et al. 2016). This new funding environment has come with increased use of development indicators and metrics that are quantified outside direct research efforts, such as 'farmer adoption', 'training and participation rates', among others. In this context, many funding agencies increasingly base their investments on how effectively research results contribute to metrics of use, as evidenced by funders' use of terms like 'outcome investing' (BMGF 2017) and 'value for money' used by OECD (Jackson 2012). Overt focus on such metrics with limited nuanced interpretation risks a reductionist perspective of technological change, potentially disregarding farmer technology adaptation, dis-adoption, and the external drivers of technological change (Glover et al. 2016; Kiptot et al. 2007). Consequently, contemporary development oriented agronomy appears to prioritise the demonstration of positive results, rather than critically reflect on the relationship between applied research methods and development outcomes, i.e. increased agricultural productivity, income, and/or food security (Andersson and D'Souza 2014; Glover et al. 2016).

For instance, the second phase of the Consortium of international agricultural research centres' CGIAR Research Programs (CRP) targets that 350 million farmers will adopt improved agronomic practices and varieties by 2030, with the ultimate goal of lifting 100 million people – half of whom should be women – out of poverty (CGIAR 2016).

Research station trials have long been complemented by on-farm and participatory research. The pressure to move quickly from piloting and refining technologies to demonstrating their impact at scale has, however, led on-farm experiments to be increasingly utilised as a method to both *understand* and *spur* farmer technology adoption (Andersson and D'Souza 2014). In other words, new funding priorities appear to have shifted agronomy from a focus on technology development and evaluation, to the practice of development itself.

The way researchers deal with this new situation they are faced with – in terms of their choice of methods and working modalities – has important ramifications for both the research process and outcomes.

In this paper we aim to understand the challenges that development oriented agronomists are faced with, and how they are coming to grips with this new context for applied research. More specifically, we ask: 'what are the implications of the increased pressure to demonstrate rapid farmer impact at scale for the use of on-farm trials in scaling agricultural technologies?' In response, we draw upon insights from Science, Technology and Society (STS) studies and Political Agronomy. STS is an interdisciplinary field that examines how science and technology evolve in society over time. A fundamental theoretical contribution of STS is the perception of science as a socially embedded practice, characterised by different cultures of practice (Crane 2014). STS can be applied to many scientific disciplines and socio-cultural settings; most STS literature however is limited to science and technology in Western societies (Pinch 2012), or experimentation in general (Maat and Glover 2012). This paper applies an STS perspective to the context of contemporary development oriented agronomy, while building on Bruno Latour's key insight that there is an inherent tension in experiments in the natural sciences, as researchers are caught between providing evidence while *simultaneously* having to persuade a selected audience (Latour 1993; Latour and Woolgar 1979).

We also draw upon recent insights from Political Agronomy that views agronomic research as politically situated practice (Sumberg and Thompson 2012). This facilitates the analysis of the consequences of a changing donor landscape and the use of on-farm experiments in agricultural development. Combining these two analytical frames, we evaluate the premise that on-farm trials can be used as a means to understand and foster widespread technology adoption by smallholder farmers. We further reflect on whether combining evidence generation and persuasion in on-farm trials results in desirable development outcomes. This paper builds on three case studies of the organisational practices of research organisations conducting on-farm experiments for scaling agricultural technologies in southern Africa, Ethiopia, and Bangladesh.

3.2 Methodological approach

Research approach

The methodological approach differs from more conventional agronomic studies. Rather than based on *a priori* outlined research procedures geared towards hypothesis testing, the research was empirically driven and inductive in nature. Reflecting on field observations and experiences, we developed three qualitative case studies of AR4D projects that employ on-farm trials as a central part of their strategy to encourage farmer technology adoption at a large scale. Each author is or was involved in one case study, respectively, as social scientists (southern Africa case and Ethiopia cases), and systems agronomist (Bangladesh case). Participant observation, a research method most commonly used in social anthropology but also in development studies, was used as the primary mode of data collection (van Donge 2006). With participant observation, researchers minimally disturb the social situations studied, in order to capture unbiased and primary information (Spradley 1980). In addition to participant observation, project documents, on-farm trial results, interviews and focus group discussions with farmers, project colleagues and partners, were used to collect data.

We present three independent case studies. The analysis of the these studies is not intended to be representative of the large diversity of AR4D projects that employ on-farm trails to collect agronomic data as well as to scale-out agricultural technologies. Rather, our use of the case study method is to illuminate principles of social organisation in AR4D practice by examining specific situations (van Donge 2006). The three case studies show how issues relating to the use of trials for scaling are not unique, incidental or purely context specific. Many of the organisational practices analysed, such as the selection of research sites and trial-hosting farmers, seem to be typical for contemporary AR4D projects as they manifest themselves in rather different institutional contexts. The analysis of three cases thus provides a perspective with wider applicability; one that can be used to assess the use of on-farm trials in other research for development projects.

Case study descriptions

Southern Africa

Since 2004, successive AR4D across southern Africa have focused on scaling conservation agriculture (CA) practices with the aim to improve smallholder farmers' livelihoods, food security and resilience to climate variability. Organised as collaborative projects between international agricultural research institutes, national research and extension programmes and NGOs, these projects bring together researchers, farmers and development actors around so-called demonstration-trials or demo-trials that aim to simultaneously study and scale CA practices. These demo-trials constitute the central project activity around which additional activities such as trainings, field days and innovation platforms are organised. The author of this case study, who was involved in innovation platform related-project activities and technology adoption research, collected data for this study through participant observation during agronomists' trial inspection visits in selected project sites in southern Africa in 2013 and 2014 (Figure 7).

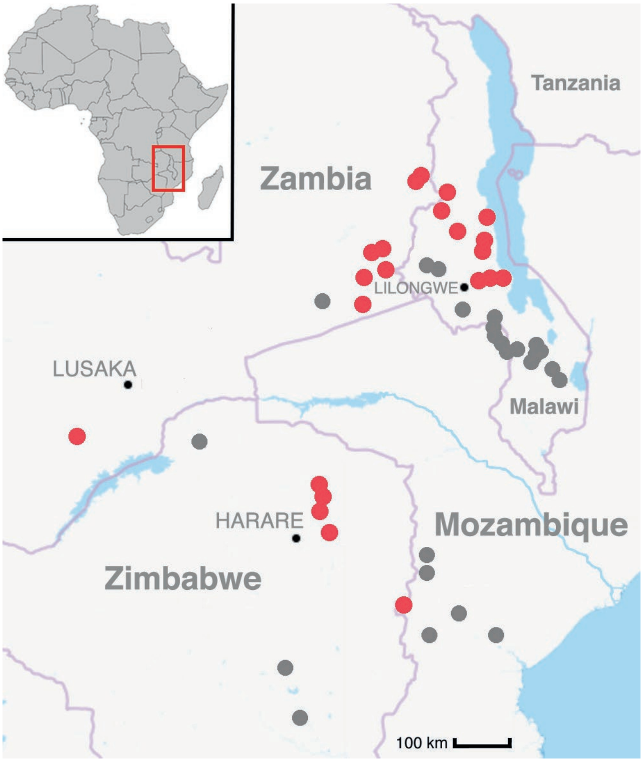

Figure 7 On-farm demo-trials sites in southern Africa
Each dot represents 4-8 replicates of conservation agriculture focused AR4D projects in southern Africa, between 2004-2015 (visited field sites in red).

Ethiopia

The second case study analyses the organisation of on-farm trials during the first three years (2011-2014) of the Capacity building for scaling-up of evidence-based best practices in agriculture in Ethiopia (CASCAPE) project in Ethiopia. This Dutch-financed project was designed to support the Ethiopian government's Agricultural Growth Programme, mainly through the generation of evidence on best practices in smallholder agriculture. Six implementing Ethiopian universities introduced agricultural technologies that increase food crop productivity in 30 so-called high potential districts (Elias and van Beek 2015; Figure 8). The author of this case study is employed as a social scientist by Wageningen University and Research, which provides project management and technical backstopping in the project. Between 2012-2014, project work was combined with participant observation and interviews with project staff, farmers, and extension agents. Before the start of each interview, respondents were always asked for their consent to use the interviews as qualitative data for research purposes. In addition, project reports and interviews were analysed qualitatively, while scoring methods were employed for quantitative data extracted from project publications. Of the six partner universities, only two had submitted sufficiently reliable data from their on-farm trials to justify detailed study (which took place in 2014). These universities were therefore selected for further examination. The data used for this case study, and the subsequent picture that emerges from it, covers the period 2011-2014 and may not reflect practices in the second phase of the CASCAPE project (2016-2019).

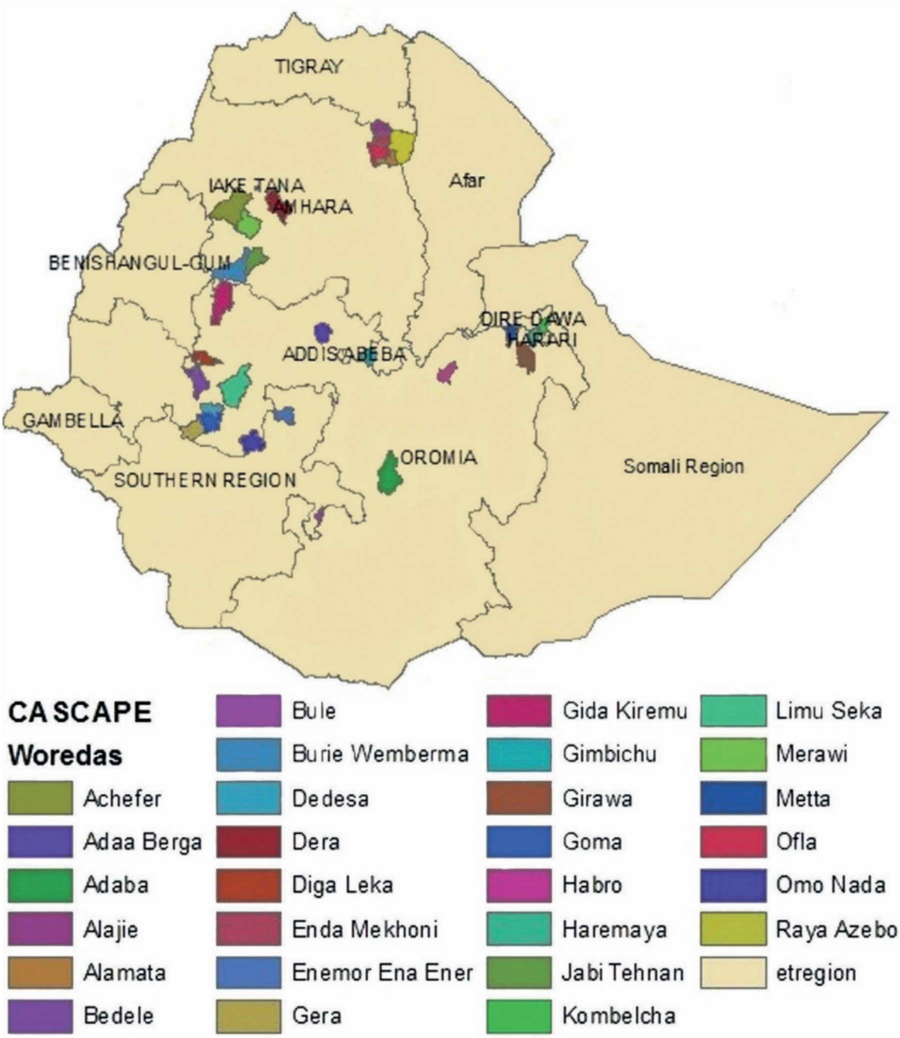

Figure 8 Intervention districts of CASCAPE in Ethiopia (2011-2015).
Each district has an average of 378 sites (i.e. farmers' fields and/or farmer training centres' demonstration plots) where on-farm experiments were carried out throughout the project.

Southern Bangladesh

The third case study addresses farmer participation in projects in Bangladesh. The Cereal Systems Initiative for South Asia in

Bangladesh (CSISA-BD) was an AR4D initiative funded by the United States Agency for International Agricultural Development (USAID). Implemented by three CGIAR centres, CSISA-BD sought to increase smallholder farmers' incomes through agronomic and aquacultural management interventions. While CSISA-BD was also operational in northern Bangladesh, this case focusses on USAID's 33,750 km^2 'Feed the Future (FtF) Zone' in the country's south (Figure 9).

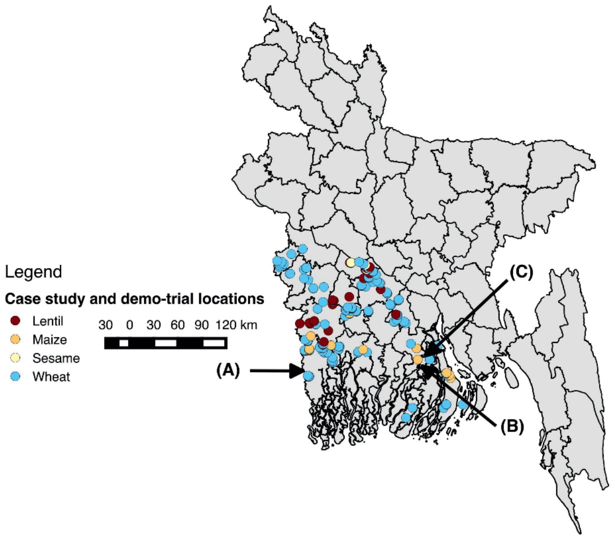

Figure 9 Bangladesh case study locations within the 'Feed the Future' zone.
(A) The Kaliganj Upazila, Satkhira, (B) Babogonj Upazilla, and (C) Lalerhat char (see case study). Dots represent seed drill machinery 'step' demonstration-trial locations in the 2013-14 dry rabi season. Black lines indicate District boundaries.

More than 30 development projects implemented by over 40 organisations are active in Bangladesh's FtF zone, which was chosen by USAID due to the region's high poverty incidence and climate change disaster risks. Achieving development impacts at scale is a core goal of the FtF programme. This case study's author was involved in CSISA-BD as an agronomist who led the implementation of farmer participatory experiments and extension activities in parts of the FtF zone, in addition to project management. The case study builds on participant observation and focus group discussions (FGDs) from 2011-2015 in this capacity. Prior to FGDs, participants were requested for formal consent and assured of anonymity (USAID 2016a). Additional quantitative data from particular field experiments conducted by the International Maize and Wheat Improvement Center (CIMMYT), selected to illustrate challenges encountered in the implementation of on-farm trials, were analysed using classical statistics as detailed in the case study.

3.3 Case studies

Conservation agriculture demo-trials in Southern Africa

Introduction

Building on one of the oldest methods in agricultural extension – demonstration – the demo-trial model addresses a heterogeneous audience. Used in scaling-focused CA projects in southern Africa, demo-trials not only produce evidence for scientists (Cheesman et al. 2016; Ngwira et al. 2014; Thierfelder et al. 2015; Thierfelder et al. 2015) as all scientific experiments do (Latour and Woolgar 1979). They also explicitly target an audience of farmers, who are expected to replicate the practices of the trials on their own fields. Enhancing the capacity of increasing numbers of farmers to replicate demo-trial results, constitutes the core mechanism of trial-based scaling, as a project document suggests: *"These [demo-trial] plots serve both as a demonstration vehicle for farmers and the project encourages the host farmers who manage the plots and participate in all activities to be the protagonists in extending the technologies based on their experiences. At the same time, because the plots are organised in such a way that they can be statistically analysed, researchers use the results to validate the effectiveness and efficiency of the technologies" (Project Completion Report 2011).*

This case study highlights the inherent tension in the demo-trial model by discussing the organisational practices of agronomic researchers and their collaborating partners, such as site and farmer selection, demo-trial supervision and management. Revolving around the re-creation of controlled experimental situations (replications) in farmer fields, the studied demo-trials unintentionally undermine farmer adoption at scale.

Demo-trial location, management protocol, and implementation modalities

Demo-trials are researcher-designed agronomic experiments, implemented by farmers. In order for their successful implementation as on-farm experiments, project officials requested selected farmers to commit themselves and a plot on their farm for several seasons. This simultaneously enables repeated measurements for the trials' scientific audience, and farmer learning of new technologies and practices. Trial-hosting farmers received inputs (fertiliser, seeds, herbicides and pesticides) for the trial plots at reduced cost (and/or on credit), as well as technical support from technicians and/or government extension or NGO staff.

Agronomists and their extension partners jointly selected demo-trial sites and trial-hosting farmers, often based on the collaborative partners' history in an area and existing relations within farming communities. For instance, one project used criteria such as the presence of partners in the area, adequate infrastructure for trial management, and existing farmer collaborations that could be built upon. These were weighed against potential failure risks. Primarily concerned with agronomic data collection, researchers thus aimed to implement well-managed demo-trials. They did so by seeking synergies with existing farmer support infrastructure, which also reduces transaction costs and allows farmers to gain hands-on technical experience.

This organisational set-up has two important consequences. First, by partially devolving control over the site and farmer selection process to partners, selection bias may be introduced, which can undermine researchers' goals to evaluate the consequences of CA under farmer management. Aiming to be good project collaborators, partners are likely to select farmers capable of re-creating well-managed trial plots reminiscent of those found on research stations. They are also likely to select farmers with fields in locations that are easy to access and monitor. These farmers are not necessarily representative of the larger, socio-economically differentiated, population of farmers to which the CA technologies were to be scaled.

Second, project partners' intervention histories, and operational modalities also appear to influence the organisational set-up of the demo-trials. For example, in most locations individual farmers were selected to implement a single demo-trial replicate on their farm. In at least one location (in Zimbabwe), a group approach was followed with 6 to 10 farmers jointly managing a single replicate on a field of one of the group members. This collective action approach was apparently analogous to a project partner's intervention modality in that area. Both trial management modalities were nonetheless analysed as independent replicate blocks. Group-managed plots nonetheless proved less suitable for replicating experimental conditions. For example, farmers were encouraged to share trial management tasks. Equal but small individual shares in the demo-trials' harvests and the possibility of the field owner demanding a larger share of the yield, seem to have created free rider problems that negatively impacted trial management and consequent data. Comparisons between farmer fields and demo-trial fields revealed that – unlike the demo-trials managed by individual farmers – trial-hosting farmers achieved higher yields on their own fields than on the group-managed demo-trials, even when they applied less fertiliser (Cheesman et al. 2017).

On-farm experiments: generalisable results?

As the above quote of from the project document illustrates, agronomic researchers employing the demo-trial model seek an arrangement that yields statistically analysable data.

This requires that the experimental situation is standardised as much as possible, and differences between blocks controlled or monitored so these can be used as explanatory variables. Such standardisation may, however have unintended consequences for scaling.

First, agronomists' preference for establishing demo-trials in close proximity to ensure similar biophysical (e.g., soil and microclimate) conditions, limits their outreach (Figure 10, next page). Researchers' concern with clustering trial replicates under similar circumstances is reminiscent of on-station randomised block agronomic experiments established on one field. When demo-trials require the use of new farming equipment – such as CA ripper-tines and direct seeders – geographical concentration of trial replicates also enables equipment sharing, which lowers costs. Living near one another, receiving instructions together, sharing equipment, being visited frequently by technicians; all this enhances demo-trial-hosting farmers' capacity to replicate, that is, to implement trials according to researchers' guidelines. Yet, the thus formed group of farmers implementing the same practices may also obscure the potential variability in farmer practices and technology performance across different biophysical and socio-economic environments. In addition, the geographical concentration of demo-trials – sometimes in areas that are distinct or secluded from a wider farming community – hampers their function as 'demonstrations' and hence, their replicability at scale. Demo-trials established on farms in resettlement areas in Zimbabwe exemplify this. These farms are often not only geographically isolated, they are usually also located on better soils, larger and often owned by wealthier farmers (Dekker and Kinsey 2011). This limits their value as demonstrations for the wider farmer community (Figure 11, next page).

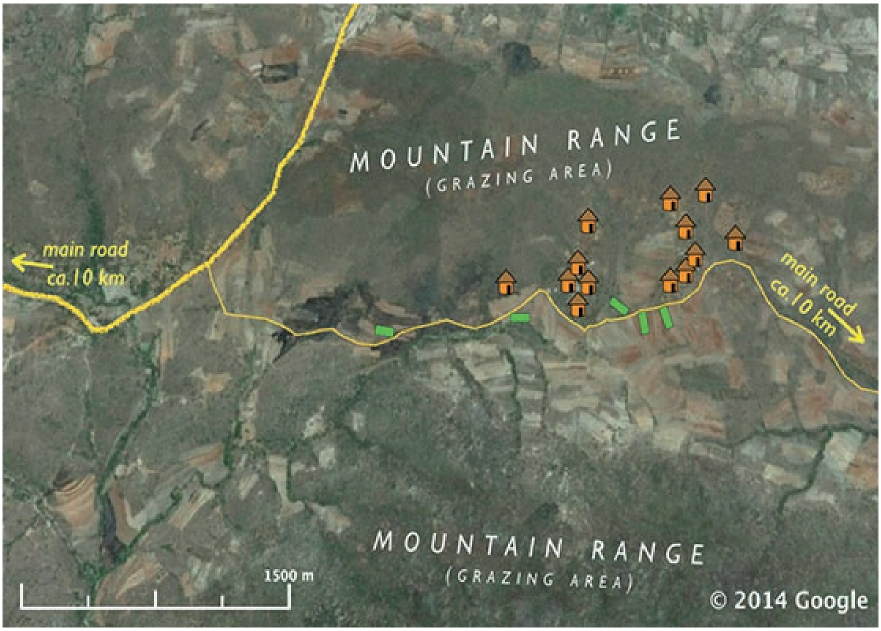

Figure 10 Example of demo-trial site in an isolated location
Replications (green boxes) are in close proximity of each other in a geographically isolated location in a resettlement area, northern Zimbabwe.

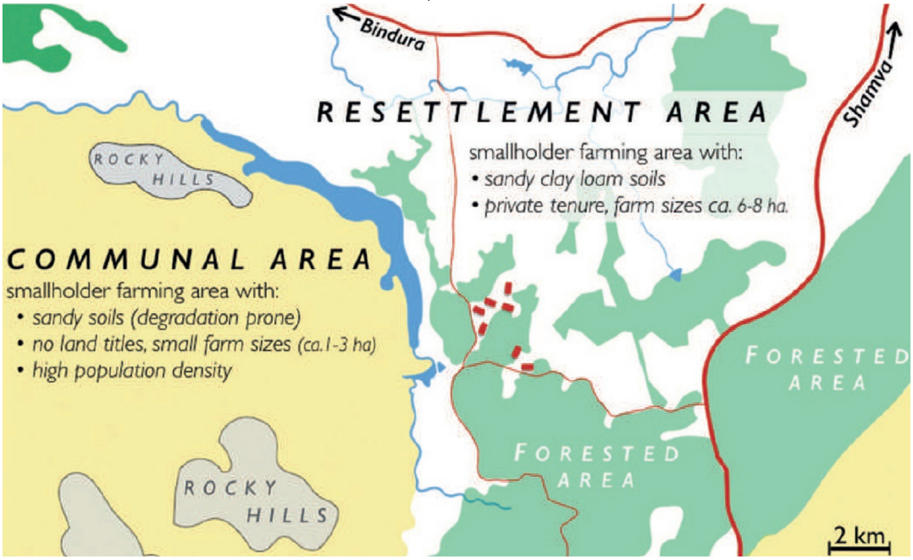

Figure 11 Example of a demo-trial site with distinct farm and soil types
Large-scale farms in a resettlement area (white area) and small-scale farms in a Communal Area (yellow area), northern Zimbabwe. Red rectangles are trial replications.

A second concern is the standardisation and control of the experimental situation. In order to ease statistical comparison of the demo-trial replicates, farmers were provided a standardised package of seeds, fertiliser, herbicide and pesticide inputs. Input costs were to be repaid by hosting farmers following harvest, either in cash or grain. Such use of standardised input packages and prescribed management regimes serves to (re-)create controlled experimental situations on farmers' fields. Yet, it can also obscure socio-economic differences among farmers that are likely to influence CA management under real-world circumstances (Giller et al. 2009). In other words, farmers' management of CA fields outside the experimental setting – where different crops, fields, livestock, and off-farm livelihood activities compete for farmers' attention – may differ substantially from demo-trial management.

Farmer selection and trial evaluation in Ethiopia

Introduction

Building on the paradigm of farmer participatory research as developed in the 1980s, CASCAPE is premised on the idea that the likelihood of technology adoption increases when farmers participate in technology selection and testing (Wageningen University and Research 2012). CASCAPE also focused on 'integrated technology evaluation', referring to a protocol that technologies should be evaluated based on multiple criteria, including farmers' preferences, yield, costs and benefits, gender equity, and environmental criteria (Wageningen University and Research 2012). By focussing on two aspects that influence utility of using on-farm trials to assess and encourage technology performance and scaling, respectively, including the selection of trial-host farmers and trial evaluations, this case study contrasts these organisational principles with CASCAPE's implementation practice.

Participatory technology development

Based on extensive participatory rural appraisal exercises in 30 intervention districts, CASCAPE's implementing universities proposed improved agronomic practices or technologies thought to fit the agroecological zone and farming systems of respective project districts (Wageningen University and Research 2013a). Most entailed 'off the shelf' technologies developed by regional research institutes, including disease resistant wheat (*Triticum aestivum*) varieties. If no existing technologies were available, researchers proposed an innovation for design and testing. Subsequently, roughly two types of trials were implemented: (1) testing innovations, and (2) demonstration-trials for known technologies. Farmers were to host, manage and jointly evaluate results from both trial types. CASCAPE's management and its university teams jointly established the criteria for technology evaluation (Table 5). Trials were iterative, and after a negative evaluation, unpromising technologies or practices would be either dropped or modified. Positive evaluations would advance technologies to the next testing phase (Figure 12). When pre-scaling trials produced what CASCAPE's researchers felt to be sufficiently and consistently positive results, the positively evaluated agronomic technologies were 'handed over' to the government for scaling.

Table 5 Criteria used for evaluating agricultural technologies in CASCAPE

Criterion	*Dominant variable(s)*
Agronomic	Yield (depending on the type of trial also other variables were measured)
Economic	Marginal Rate of Return (MRR), Partial Budget Analysis, Cost/Benefit Analysis (based on CIMMYT (1988). From agronomic data to farmer recommendations, an economics training manual.
Farmer preference	Preference ranking based on farmer criteria CIAT (2001). Farmer evaluations of technology: preference ranking.
Gender	Sex disaggregated labour requirements needed for the technology and intra-household benefit sharing
Nutrition	Effect on the nutrition security of the household
Environmental sustainability	Nutrient balances, soil organic matter content, pesticide requirements

Source: Interviews with project staff, 2014

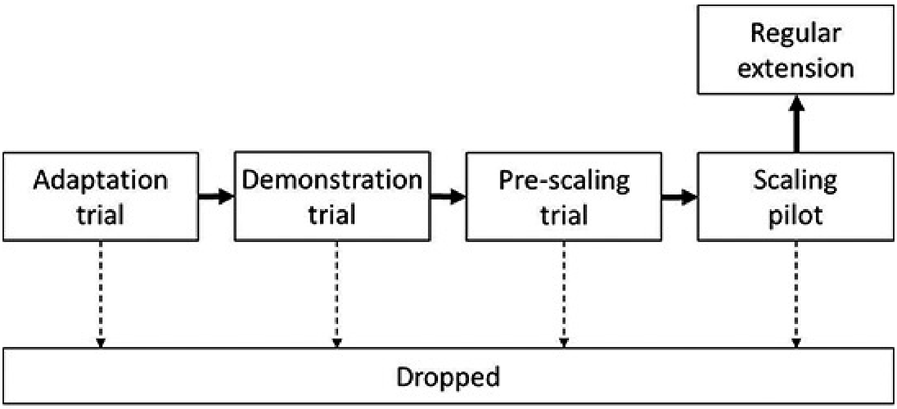

Figure 12 CASCAPE's technology development and scaling strategy (2011-2015)

The rationale behind the 'chain' of on-farm trials (Figure 6) was that while a technology or crop management practice moves from the development and adaption to scaling stages, the conditions of testing and evaluation are supposed to gradually change from a research setting towards farming reality (Abebe et al. 2015; Elias and van Beek 2015). The Ethiopian agricultural research and extension system was also expected to gradually assume leadership of the scaling process.

These arrangements were intended to improve the potential for rapid farmer adoption. Between 2011-2014, 7,869 farmers participated in on-farm trials and field days, 14% of whom directly hosted on-farm trials (Wageningen University and Research 2015).

Farmer selection

In CASCAPE's first phase, trial-host selection criteria were not very clear. Without explicit guidelines, university coordinators had relative freedom in farmer selection and trial organisation. Selection practices introduced a number of biases in trial-host selection. In most cases potential trial-hosting farmers were first identified in collaboration with the district extension personnel. While such partnership at first appears advantageous, CASCAPE quickly encountered problems. Government extension policy mandates the introduction of new technologies first to 'model' farmers thought of as innovative and capable to adopt technologies, after which other farmers are expected to follow (Ministry of Agriculture and Natural Resources Ethiopia and ATA 2014). Extension workers could therefore be quite persistent in their preference: *"During a gender activity analysis conducted in 2014, we (CASCAPE) were supposed to select 50 farmers, 2/3 being 'non-model' and/or female. It seemed almost impossible to convince the extension agent to include so many 'non-model' female farmers in the sample. The extension agent continued to bring male and 'model' farmers for us, telling us that they were the best examples to be included." (Interview with project staff, May 2014).*

CASCAPE's agronomists and livestock fodder experts, working in their respective university teams, continuously indicated their concern that the technology evaluation trials must also be successful as demonstrations. Poor or female farmers, they argued, may not have sufficient land, oxen, or labour, and may lack the knowledge, experience, and time required to adequately manage experiments, thereby risking trial 'failure': *"It is difficult to select female headed households, because they often do not have enough labour to plough and sow in time. We experienced this several times resulting in delayed planting... Female farmers are generally not seen as a good example for other farmers. So selecting a women farmer is also not helpful to convince other farmers to adopt the technology." (Project agronomist, interview August 2015).*

Creating ideal conditions for technology performance, rather than technology evaluation, emerged as a major concern: *"The farmer needs to be knowledgeable and needs to have the necessary resources and interest to manage the trial well. If not, the trial might fail. Our job is to show that the technology works, it is the job of extension to make sure that other farmers will adopt it." (Project agronomist, interview February 2014).*

Agronomists therefore tended to select farmers they described as more 'serious', who could serve as positive examples in their villages. Preference for educated and better-off farmers with prior trial experience, and who were expected to follow agronomists' recommendations, was common.

Franzel et al. (2001) pledge to separate trials according to their goal: type I trials (researcher designed and managed) to evaluate biophysical parameters, type II trials (researcher designed but farmer managed) for evaluating economic parameters, and type III trials (farmer designed and managed) for evaluating farmers' preference. In CASCAPE, this distinction was not made. Despite CASCAPE's emphasis on iterative and participatory technology vetting under farmer conditions, agronomists struggled to leave the management to farmers (only), because they feared trial failure. They thus appeared to favour proving new technology performance over farmer management. Two observations illustrate this point. Firstly, data from farmers who did not manage trials adequately were occasionally excluded from analysis, without accounting for the reasons for poor management. Where poor management may have resulted from farmers' prioritising other livelihood activities, for example a more remunerative off-farm activity, exclusion of the trial results constitutes a missed opportunity for researchers to learn about technology performance outside the experimental setting. Secondly, the labour needed for land preparation, planting, weeding and harvesting in the trials was in some cases paid for by the project to ensure that the plot was well managed from an agronomic perspective. As a result, researchers not only missed an opportunity to learn why farmers may be unable to implement a new crop management practice or technology in their own fields. Such practices also undermined technology evaluation under 'real' farmer management.

These approaches to experimental implementation and management resulted in selection biases favouring male and 'model' farmers as trial-hosting farmers in the early phases of the project (Figure 13).

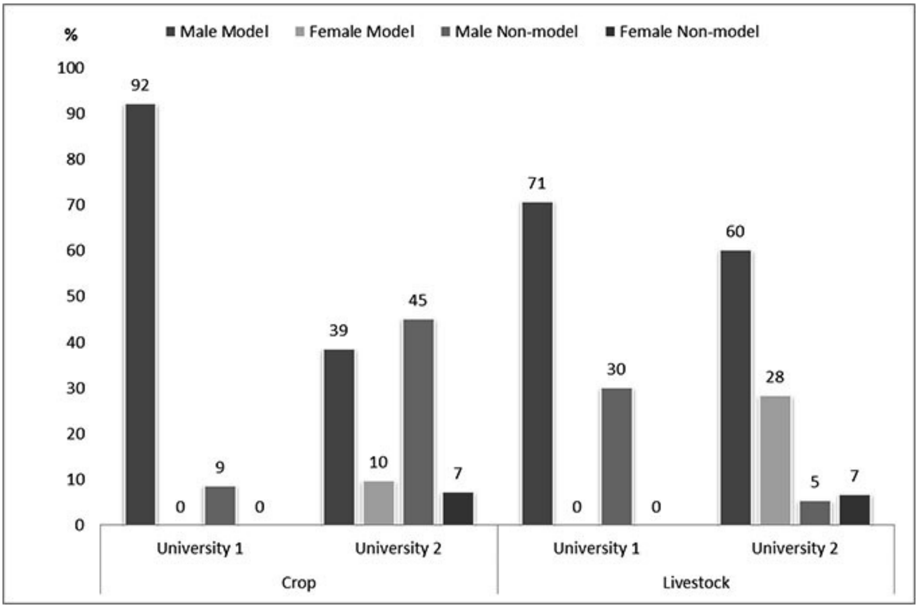

Figure 13 Farmer selection for on-farm trials (2012-2013)
Percentage of male, female, 'model' and 'non-model' farmers selected as host for CASCAPE on-farm trials in 2012 and 2013 by two (of the five) universities (Wageningen University and Research 2013b, 2014).

On-farm trial evaluation

Although CASCAPE established criteria for multidisciplinary trial evaluation, most technologies were promoted from adaptation to pre-scaling mainly based only on reported yield performance. Figure 14 shows that while in almost all annual reports agronomic data were presented (i.e. yield data), only less than half of the reports presented a farmer preference analysis and only in one out of five reports an economic analysis was reported (Wageningen University and Research 2013a 2014).

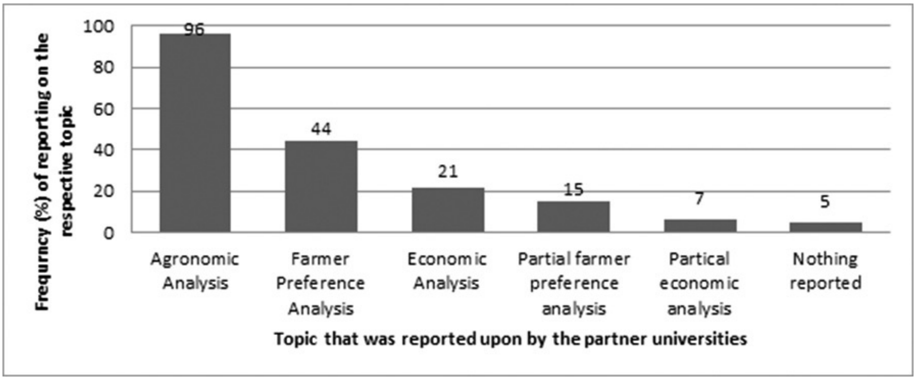

Figure 14 Frequency of reporting on different data types (2013-2014)
Three broad categories of data types: agronomic, economic and farmer preference analysis data from on-farm trials in 2013 and 2014 (n = 101). Source: Project annual reports of six participating universities, 2013 and 2014.

Problems and pitfalls of trials for scaling in Bangladesh

Introduction

Bangladesh is the globe's most populated agrarian nation. Forty-nine million people, many of whom are farmers, subsist below the poverty line (MoA and FAO 2013). In addition to its strategic geopolitical importance, Bangladesh attracts considerable development assistance. Over USD 17.4 billion were awarded by various donors between 2000-2009 (World Bank 2015). Approximately 230 international NGOs and six CGIAR institutes work in Bangladesh (Gauri and Galef 2005). Coordination among projects is complicated by differing donors and development organisations' agendas. This case study provides examples of difficulties encountered in managing on-farm trials implemented by CIMMYT, a partner in the CSISA-BD project. We then describe how the project matured and shifted from a focus on agronomic trials for scaling to a more systems oriented research and extension agenda.

<u>Scale or reach? Farmers' motivations for participation</u>

In Bangladesh, AR4D projects increasingly compete with NGOs and private sector development organisations for project funding. Mandates to deliver impact at scale among the rural poor are now common. This new funding environment has ramifications for how AR4D projects are implemented and how farmer participation is recorded and reported to donors.

USAID's FtF indicators for example require projects to count farmers including "… the total number of farmers, ranchers and other primary sector producers, etc. that applied new technologies anywhere within the food and fibre system as a result of US government assistance…" (USAID 2016). Emphasis is thus placed on use of technologies and crop management practices rather than on sustained adoption (or dis-adoption). Similar approaches are utilised by other major donors. Development organisations can therefore achieve farmer-beneficiary targets by assuring that many farmers simply try out new technologies, including participation in demonstrations and/or on-farm trials. The broader political economy of development therefore appears to be at least partially driven by the need for projects and donors to demonstrate large numbers of project beneficiaries, in order to justify continued bilateral investment. Different organisations also have different approaches to engaging farmers in development activities. Where coordination among organisations is poor, AR4D efforts may suffer. For instance, when CIMMYT researchers asked farmers to participate in demonstration-trials during the CSISA-BD's inception phase, they were told: *"Save the Children was here last week. They will give education for our children and we have asked them for a deep tube well. What are you able to give us for planting your crops?" (Farmer commentary, Kaliganj Upazila, Satkhira, September 2011).*

This example demonstrates how farmers may approach participation pragmatically, valuing the potential economic benefit from engaging with researchers over the research process itself. CSISA-BD conversely discouraged direct payment and material transfer to farmers, although this often made it difficult for researchers to implement fieldwork. Over half the farmers in USAID's FtF zone are landless tenants (MOA and FAO 2013). They may therefore approach the sharing of land for trials and demonstrations from the perspective of tenant-landlord relationships. Farmers in In Babugonj Upazilla, for example, commonly requested additional financial compensation for the land used for participatory wheat varietal trials in the early phases of the CSISA-BD project, despite agreements that any yield loss caused by the experiments would be compensated. Problems were also experienced with implementing experimental protocols. Some farmers, for example, avoided labour-intensive weeding practices despite consistent requests by researchers. In order to reduce the risk of demonstration-trial failure, and to assure quality data, research technicians frequently responded by hiring labourers to manually weed. By doing so, participating farmers in adjacent villages reasoned that the project would support additional labour and also withdrew from weeding the following season.

Emerging dependency syndrome

In CSISA-BD, CIMMYT demonstrated small scale agricultural machinery to farmers (Figure 15). Many demonstration-trials emphasised agronomic methods for the conversion of fallow land to wheat cropping. On Lalerhat *char* in Barisal District, 13 farmers were engaged on 10 hectares of their own land to implement large scale demonstration-trials of mechanised row-sown wheat. With CIMMYT input support, farmers implemented researcher-designed, farmer-managed multiple-plot 'step' demonstration-trials in a dispersed randomised block design. Treatments included farmers' own nutrient and weed management practices with manual broadcast seeding (T1), farmers' own nutrient and weed management practices but with machine sown wheat (T2), and extension service recommended nutrient and weed management practices with machine sown wheat (T3) (Table 6). Moisture corrected yields were measured from the sum of five randomly placed 2 m^2 quadrats $plot^{-1}$.

Table 6 Experimental design for Lalerhat char (2013-14 season)

Treatments	*Treatment details*	*Yield (t ha^{-1})[a]*
T1: *Farmers practice*	Wheat established by hand broadcasting. All other management decisions at farmers' individual discretion.	3.09 c
T2: *Farmers' practice with machine-aided line sowing*	Wheat established by two-wheel tractor aided machine line sowing. All other management practices implemented as in T1.	3.49 b
T3: *Farmers' practice with machine-aided line sowing*	Wheat established by two-wheel tractor aided machine line sowing, with all other crop management principles following nationally recommended practices and rates.	3.72 a

a. Significant ($P < 0.001$) yield differences detected following ANOVA. Data in column not sharing the same letter are significantly different according to Tukey's HSD test at $\alpha = 0.05$.

Trial results indicated significant ($P < 0.001$) 0.4 t ha^{-1} yield increases from T2 compared to T1. Further significant yield increases of 0.63 t ha^{-1} were also observed when comparing T1 to T3.

After the season, farmers however commented that they would be unable to afford or find sufficient fertiliser for the elevated rates (61, 2.8, and 65 kg more N, P, and K ha^{-1}) required for the T3 (recommended practice) treatment. In the following 2014-15 dry season, CIMMYT withdrew from demonstration-trials but continued to observe farmers' practices and performance. Only 8 of the original 13 farmers opted to grow wheat. The remainder opted for less input intensive yet profitable legume crops, or reverted to fallowing. One of the eight farmers nonetheless purchased the mechanised seed drill as used in the previous year's demonstration-trials, and planted the other farmers' fields on a fee-for-service basis. Despite the agronomic performance of T3 in the previous year, farmers who grew wheat used methods similar to T2, by employing their own management practices with machine sowing, rather than adopting recommended management techniques.

Growing conditions in the 2014-15 dry season were similar to the previous year. Yield data were collected as in the 2013-14 season. Comparing data collected from these farmers, yields were however significantly ($P < 0.01$) and 1.27 t ha^{-1} less than T2 in the previous season (Figure 15). Follow-up discussions revealed that the poorer wheat performance probably resulted from farmers' reduced willingness to actively manage weeds in the absence of regular researcher visits. Although small in number, this case illustrates the problems associated with scaling metrics and indicators that measure farmers' application of a technology alone, without further examination of the quality of continued technology use outside of demonstration-trial and project mediated settings.

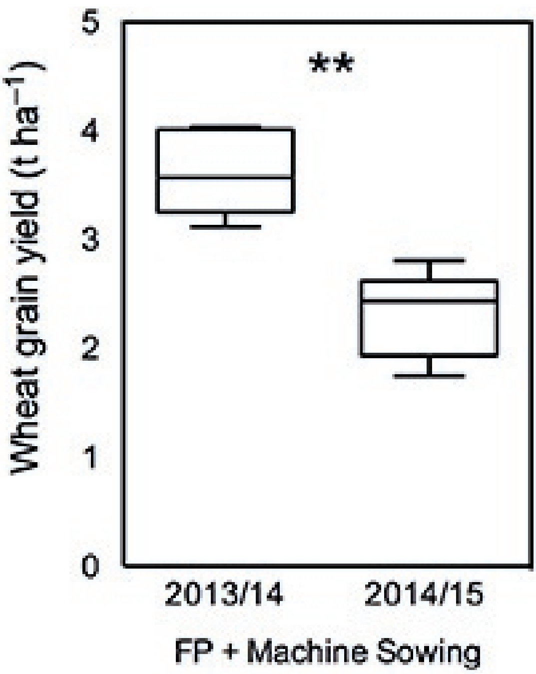

Figure 15 Machine drilled wheat yield decline under farmer practice
This figure compares farmers' own management practices (FP) on Lalerhat char between the 2013-14 and 2014-15 dry season following the withdrawal of researcher trials. ** indicates $P < 0.01$, $n = 8$.

3.4 New approaches to AR4D

Subsequent projects implemented by CSISA-BD partners continued to focus on small scale machinery. While still AR4D efforts, these initiatives placed more attention on interventions aimed at creating a favourable policy and market environment to enable adoption and scaling. Built on theories of change and using value-chain approaches, these new efforts aimed to overcome bottlenecks in the supply of machinery by linking farmers to machinery service providers, dealers, and manufacturers. In other words, linear technology-transfer approaches associated with demonstration-trials were downplayed in favour of innovation systems development AR4D. Research agendas also shifted to emphasise systems analysis and studies of adoption constraints to better guide efforts to increase farmer-to-farmer technology diffusion.

3.5 Discussion

In the 1980 and 1990s, STS scholars made detailed analyses of how natural scientists conduct and write about experiments (Gooding et al. 1989; Latour 1987). These studies provide insights that are highly relevant to the understanding of on-farm experimentation in contemporary AR4D. Paramount is the problematisation of the dual role of experiments: providing evidence while also persuading selected audiences that the technology in question ‘works’. Each case study has revealed how this dual role applies to on-farm trials: they are employed to evaluate if a given technology ‘works’ under smallholder farming circumstances, while simultaneously being used to convince other scientists and farmers of the success of the given technology. While this has long been the case for AR4D, the three case studies suggest on-farm trials now have a third audience - donors interested in impact at scale.

The donor audience is interested in somewhat different evidence than scientific or farmer audiences: metrics of adoption and farmer participation have become necessary to prove that technologies ‘work’ *and* create impact at scale (BMGF 2017; CGIAR 2016; Jackson

2012). Pushed by this metrics agenda, the nature of agronomic evidence production has shifted from technology assessment (i.e. yield and economic performance, environmental impacts, etc.) typically presented in journal papers, to include ‘head counting’ (i.e. number of farmers participating in trials, number of farmers applying a technology), widely reported in project documents and donor reports.

The case study from Bangladesh is particularly explicit about the consequences of this donor focus, stressing the problematic emphasis on application rather than adoption (or dis-adoption) dynamics, while indicating that projects can achieve beneficiary targets simply by assuring that many farmers try out new technologies. This situation becomes even more problematic when farmers are given incentives to participate in technology testing or demonstrations to meet the metrics required by donors. Without independent evidence substantiating farmers’ interest in sustained use of improved technologies, such metrics can provide the misleading indication that a given technology ‘works’, while the produced metrics are merely an artefact of the AR4D process itself. Moreover, farmers may position projects or NGOs against each other for increased social, material or monetary gain.

Besides a perspective on the audiences of experiments, STS studies have drawn attention to the tension between providing evidence and persuasion. Latour (1987) argued that the interest to persuade the audience(s) always dominates the interest to provide evidence. This is most obvious in contemporary donor-funded AR4D projects; for sustained funding, trial designers and implementers are under pressure to develop experimental treatments that outperform existing technologies and practices. As the southern Africa and Ethiopian case studies have shown, to increase the likelihood of a successful experiment, agronomists and their partners tend to (consciously or unconsciously) introduce biases when (re)creating the controlled experimental environments. They tend to select areas they already know, farmers that are 'more serious', more receptive to new technologies, live in close proximity to all-weather roads, etc. Such selection biases contribute to the creation of a receptive farmer audience, but risk compromising the external validity of the trials, and hence, their scalability. This is evidenced by the demo-trial case study from southern Africa, where replications are often located close to one another, which limits the potential for scaling-out to other areas with different biophysical conditions. In Ethiopia, biased farmer selection and a preference for yield data (over other parameters) resulted in on-farm trial results that may not be representative or relevant for the wider farming community. For instance, poor and female farmers are generally less likely to adopt labour or capital intensive agricultural technologies (Phiri et al. 2004). The Ethiopia case study demonstrates how these groups may be purposely excluded from agronomic technology testing and evaluation. This is pertinent since increased scale is typically accompanied by increased heterogeneity in biophysical and socio-economic conditions, in addition to farmers' abilities, indicating that results achieved by so-called 'model' farmers may not be fully replicable outside the experimental setting.

Next to problems of farmer selection biases reducing the external validity of on-farm experiments, there is an inherent tension within on-farm experiments. The need to control the experimental situation makes on-farm trials ill-disposed towards replication at scale – that is, by many different farmers in diverse agricultural landscapes – as increased scale is typically accompanied by increased heterogeneity in conditions. This argument was presented by Latour (1993) in his study of the microbiologist Louis Pasteur, who developed rabies and anthrax vaccines. Pasteur's vaccines only worked when the experimental conditions were transferred to other settings; extending the vaccines' use thus necessitated the 'Pasteurization of France'. The selection biases and standardisation of trial inputs and management regimes in the organisation of demo-trials can have a similar effect; they mould circumstances and farmers in such a way so that the technologies can work. Whether this is a feasible and appropriate scaling strategy is a moot point.

3.6 Conclusions

In addition to evaluating the performance of new technologies in different environments, the case studies presented in this paper demonstrate how on-farm trials are conceptualised by AR4D organisations as a tool to demonstrate new technologies and crop management practices to farmers. Participating and neighbouring farmers are often thought of by these organisations as potential adopters, and as such, agronomists – as well as other research project staff – may assume that on-farm trials can be used to understand the scaling potential of new technologies under different socio-economic and institutional environments. The perspective on on–farm trials developed in this paper problematizes this assumption. An understanding of scalability requires first and foremost an assessment of the drivers of technology adoption. Our case studies indicate that on-farm trials are in many circumstances ill-suited to understand these drivers. An understanding of the scalability of technologies requires the use of methods that can elucidate barriers to and opportunities for scaling. This requires methods that increase the insights on farmers', asset base, in- and output markets, and insights in how trends such as urbanisation and climate change affect farmers' livelihood options. On-farm trials are poorly suited to acquire these insights since drivers operating at higher levels are difficult to recreate under agronomic trial settings. Hence, a focus on scaling requires a re-orientation of both the research process and scaling activities themselves. This has important ramifications for the division of labour within AR4D organisations (what kind of scientific disciplines should be involved?), the farmers who participate (what farmers are representative?), research methods used (are manipulative trials better suited than surveys, choice experiments, or randomised control trials?), research locations (which farms to include?), and research protocols deployed (what data to collect, and how to analyse them?).

Our case studies provide evidence that the emphasis placed by funders of international agricultural research on benefitting farmers at scale can unintentionally result in a 'donor dependency syndrome', in addition to the misalignment of researcher and farmer interests. The drive to demonstrate impact at scale can thus undermine the potential of on-farm trials to serve as sites for experimentation and adaptive research. Review of the case studies also problematises the replicability of trial results when experiments are carefully staged such as experiments designed and highly controlled by researchers.

When experiments are analogous to ‘performances’ conducted under ideal circumstances (rather than under realistic circumstances and variable management), experimental results are less likely to be reproducible at a larger scale.

In order to both improve the potential for farmer adoption of promising technologies as well as the quality and rigor of agronomic science itself, this dilemma needs an urgent solution.

While on-farm experiments role in scaling may be limited, we see their continued importance, as a space for joint experimentation and adaptive research. A future direction would be to employ an interdisciplinary approach to technology introduction and testing, by embracing the environmental and social heterogeneity of farming communities, and perhaps by using randomised and representative samples of trial implementing farmers, rather than those chosen because of their ‘advanced’ abilities to manage experiments. In this scenario, on-farm trials should be complemented by assessments at other levels and including other domains, to increase the understanding of scalability of the technologies at stake.

3

Chapter 4

Scaling Modern Technology or Scaling Exclusion? The Socio-political Dynamics of Accessing in Malt Barley Innovation in Two Highland Communities in Southern Ethiopia

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Abstract

In this article we explore whether and how the dynamics of access shape the scaling of modern agricultural technologies. It is based on the experience of an agricultural research for development (AR4D) project called CASCAPE, which aims to validate and scale agricultural best practices for smallholder farmers in Ethiopia. The socio-political dynamics of external interventions are often taken for granted contextual factors in AR4D projects. By contrast, this article takes this context as the point of departure for its analysis. The aim of this in-depth case study is to unpack the concept of access as condition for scaling of agricultural technologies. We identify and analyse the mechanisms that determine access to the various components of a malt barley technology package which was introduced in two highland communities in southern Ethiopia (and later ’scaled’ to a range of other communities). Our research approach is technographic, implying that we consider the technology to contain both material and social components. The findings suggest that social and clan-based exchange mechanisms (such as clan-based loyalty, reciprocity and vertical accountability) are often rendered invisible even though they are of critical importance in governing access to the material and social components of modern agricultural technologies. Ignoring this socio-political context in the malt barley interventions resulted in an unintended scaling effect in terms of widening the social and economic gap between a few better off farmers and a larger group of poor farmers. The paper thus provides evidence that the socio-political dynamics of access to technology can have an important influence on its wide spread application and may complicate efforts to scale the uptake of technology. Paying

more attention to such processes would help to improve the effectiveness of AR4D efforts.

Keywords: accessing, scaling, innovation, smallholder agriculture.

4.1 Introduction

4

It is often argued that one way to improve food security in developing countries is to encourage the wide-spread adoption of agricultural technologies by smallholder farmers. As a result, donors are increasingly pushing for 'outcomes at scale' within Agricultural Research for Development (AR4D) (Giller et al. 2017). In some low-income countries, this pressure results in a plethora of AR4D-initiatives targeting rural communities (Pingali and Spielman 2016).

Adoption rates are a commonly accepted metric for measuring progress in AR4D, but these have increasingly become subject to critiques (Andersson and D'Souza 2014; Glover et al. 2016). One main thread of these critiques is that adoption cannot be understood as a mere binary, timeless and individual choice for the use of a particular artefact by the wider target audience as this reflects a narrow understanding of what constitutes a technology and the process of technological change. Rather, one should consider technology as a combination of social practices and material elements (Jansen and Vellema 2011). This understanding leads us to see the process of technological change as one of (re-)configuring the social and material, i.e. re-engineering the relations between the social and material components of a system (Klerkx et al. 2010; Mosely 2017). This should lead to greater acknowledgement of the importance of an enabling environment for scaling agricultural innovations. In this context much attention is paid to the challenge of enhancing farmers' access to markets for inputs and outputs, for example through improving coordination among farmers and/or other actors within value chains (Bernard and Spielman 2009; Develtere et al. 2008; Jack 2011; Markelova and Mwangi 2010).

The importance of access is well understood in the domain of natural resource management (see, for instance, Berry 1989; Milgroom 2012; Ribot and Peluso 2003). However, these insights have not yet been applied to the domain of AR4D. Unpacking the concept of access is relevant, given the high expectations that policy makers and the donor community have for the successful scaling of improved agricultural technologies. The literature on natural resources specifically suggests that 'access' is not something that can be simply 'provided' or engineered from outside, but that it involves complex socio-political dynamics of inclusion and exclusion. Similarly, rural sociologists have provided key insights into how development projects and external interventions are often dominated by local politics (Mosse 2005; Planel 2017; Platteau 2004) and may reproduce existing inequalities in local communities (Cleaver 2005). Similar processes may occur when external interventions seek to enhance access knowledge, or the use of technology, due to the prevailing socio-political dynamics. To date AR4D has not paid much attention to these socio-political dynamics. Understanding of adoption processes and the obstacles to scaling would be enriched by paying more attention to whether and how these processes occur (see also de Roo et al. 2017) and may also provide insights on opportunities for improving the effectiveness of AR4D efforts.

In this paper we aim to unpack the concept of access as condition for scaling agricultural technologies. In doing so, we take a technographic approach (Jansen and Vellema 2011) which distinguishes between, and gives equal weight to, the material and social components of a technology. We identify and analyse the mechanisms that determined access to components of a malt barley technology package which was introduced in 2012 - 2014 in two highland communities in southern Ethiopia (and later scaled to a range of other communities). While the malt-barley technology has specific material characteristics, the insights from this study have a more general relevance for agricultural innovations that are being introduced to increase agricultural productivity and food security and to reduce poverty.

This paper is structured as follows. Section two presents the theoretical framing, and section three describes the research methodology and methods that we applied. Section four describes the introduction of the malt barley technology (MBT) package in the two highland communities and the extent to which farmers applied the full package or components of it. In section five we explore the farmers' access to different components of the MBT package. Section six presents an interpretation of the underlying mechanisms that explain (non) access to the different components of the MBT package. We conclude with a discussion on the conceptual and policy implications of the findings of this case study.

4.2 Theoretical framing

In early adoption research, the dominant idea about the scaling of technology was that scaling results from an aggregation of individual adoption decisions by farmers (or other innovators and adaptors). Such ideas originate from earlier work on adoption and the diffusion of innovations, as synthesised by Rogers (1995). Nowadays, much more attention is given to the ways in which the broader social and institutional environment enables or constrains the use of new technologies, giving rise to the idea that that innovation is about re-configuring social and material components, including economic and institutional practices and rules (Geels 2002; Jansen and Vellema 2011; Klerkx et al. 2010). In essence, this means that innovation always involves multiple and simultaneous social and technical changes in a network of stakeholders who depend on each other in realising their ambitions for change (Wigboldus et al. 2016). Thus, scaling does not primarily result from isolated individual decisions about adoption, but from interactions among stakeholders who need to somehow enable each other to move forward. However, despite this increased recognition of the importance of 'enabling environments' for the scaling of technology, AR4D still places most of its emphasis on the technical rather than the institutional and social dimensions of innovation (Hounkonnou et al. 2012; Leeuwis et al. 2017; Schut et al. 2016). In the context of AR4D interventions, the creation of a conducive environment frequently includes efforts to disseminate knowledge about agronomic technologies to farmers, or enhancing farmers' access to input markets (seeds, fertiliser, pesticides, manpower, credit, etc.) and output markets. Many studies suggest that it is far from easy to effectively provide access to markets for smallholders due to a range of issues, including weaknesses in value chain governance (Barrett 2008; Poulton et al. 2010), poor horizontal coordination among farmers (Bernard and

Spielman 2009; Develtere et al. 2008; Markelova and Mwangi 2010) and/or non-conducive trade and market regulations. In this article we take a micro level perspective and explore the difficulties associated with accessing a technology and on the processes that occur in and around communities when external interventions offer access to new technologies and market opportunities. This approach is inspired by studies on access to natural resources which suggest that access is a complex socio-political process (Berry 1989; Milgroom 2012; Ribot and Peluso 2003).

Sara Berry's 1989 paper 'Social institutions and access to resources' makes an important contribution to understanding the concept of access. It provides a historical account of the various ways in which social institutions shape access to natural resources in Africa, focusing on how these institutions have adapted to the economic, environmental and political changes that have affected the continent in the past decades. She points out the importance of social relations in determining access to resources. Since people often access the means of production through indirect means, social identity and status become objects, as well as instruments, of investment. Hence, the establishment or strengthening of social relations is an integral part of peoples' strategies of production and accumulation, since these social relations often affect the terms on which people gain access to resources (Berry 1989).

Ribot and Pelusos' 'Theory of access' (2003) makes another important contribution to understanding access, positing that access to natural resources is shaped by socio-political dynamics. They define access as the ability of people to benefit from things—

including material objects, people, institutions, and symbols (p.153). In doing so, they focus on ability rather than on rights, arguing that rights do not always result in an actual ability to use, let alone to benefit from, the use of a resource. They also use the notion of 'webs of access' (p.154) to refer to the dynamic processes and relationships that shape access to resources and distinguish between *controlling* and *maintaining* access. Control of access refers to the mechanisms that regulate direct access to a certain resource, maintenance of access refers to the indirect mechanisms that people rely on to gain access to a resource (often through others). Maintaining access is particularly relevant in situations in which many, if not a majority of, smallholder farmers (or any other group), can only access certain (scarce) resources by maintaining good relations with those who control access to these resources.

These two articles provide a useful basis for understanding access as a socio-political process. Since their analysis focuses on the domain of natural resource management, they frame access to technology, knowledge, and markets merely as means for exploiting natural resources. As of yet, there have been (to our knowledge) no attempts to apply these insights to the domain of AR4D, where the focus is on how farmers access markets, knowledge and technologies. This paper aims to explore whether, and how, dynamic processes of accessing interact with efforts to foster an enabling environment for scaling modern agricultural technologies. We follow Jansen and Vellema (2011) and take a technographic approach, distinguishing between the material and the social components of a technology. Material components have a physical reality and include land, inputs (seed of an improved variety, organic and inorganic fertilisers, pesticides), manpower, oxen, oxen plough and a donkey cart. Examples of social components of a technology would include agronomic and marketing knowledge, being connected to the 'right people' and cooperative membership.

In our quest to identify the mechanisms that explain access we apply a network approach in which the community is the unit of analysis, rather than individual household strategies (Bebbington 1999; Cleaver 2005; Fafchamps and Quisumbing 2005). The use of a network approach allows us to move away from the linear and binary notion of adoption and focus on the context in which technologies are being introduced. Following Ribot and Peluso, we pay explicit attention to the mechanisms that enable or prevent people from indirectly accessing components of a technology (i.e. access maintenance), which has the benefit of regarding access as a dynamic process (Ribot and Peluso 2003, p. 158).We broadly define mechanisms as the structures, powers, relations and processes that are often not directly observable but which can be identified through their effects. Mechanisms explain 'how things work'; they are the processes through which people in specific situations gain access (or not) to the components of a technology, representing situations of scarcity.

4.3 Materials and methods

Technology selection

We studied the introduction and application of the Malt Barley Technology (MBT) package, introduced through a joint effort of the

Ethiopian Ministry of Agriculture and CASCAPE project[7]. CASCAPE is an AR4D project financed by the Royal Netherlands Embassy in Addis Ababa and managed by Wageningen University and Research and five Ethiopian universities. It aims to increase agricultural productivity in the Ethiopian highlands through the validation and promotion of best practices in agriculture (Wageningen University and Research 2015).

We chose to study the Malt Barley Technology package for a number of reasons. Malt barley is a strategic cash-crop which has received substantial policy support in Ethiopia due to its perceived potential to reduce the government's dependency on import which costs a significant foreign currency earnings and the contributions that selling the crop can make to smallholder incomes (Dumara 2017). The two main supporters of the introduction of the MBT package see the malt barley innovation as a success story of how modern technologies contribute to food security and farmer incomes (Abebe et al. 2015). Secondly, the first and last authors of this paper were involved (as advisor and regional manager respectively) to the CASCAPE project when the MBT package was introduced, which facilitated our access to local facilities for fieldwork as well as to internal project documents.

Study sites, sampling techniques and data analysis

The research took place in the Malga Woreda, Sidama Zone in the southern region of Ethiopia (SNNPR). Malga woreda was selected it is known as a high potential area for malt barley production and

[7] CASCAPE stands for Capacity Building for Scaling-up of Evidence-based Best Practice in Agriculture in Ethiopia.

because the CASCAPE project selected it as their target area, allowing the authors easy access to the woreda's administration and its farming community. We selected two neighbouring *Kebele*s (villages): Guguma and Gomeshe-Tulu.

Related research by the first author in the two study *Kebele*s made it possible to draw random samples of 65 households in each *Kebele* (130 in total) (Dumara 2017). From this sample we derived basic quantitative data on households' asset base and their access to components of the malt barley package. From this sample, we purposively selected 4 households with relatively good and 4 households with limited, or no, access to the material and social components of the malt barley package in each *Kebele*. These households formed the sample for the qualitative data collection, which mostly consisted of participant observation and in-depth interviews. Additionally, we conducted interviews with a DA (development agent), an elderly farmer, a member of the cooperative management, the *Kebele* manager (in both *Kebele*s), the credit manager the *Kebele* chairman (just in Guguma) and the woreda's representative for agriculture (in Malga). In total, 33 in-depth interviews were conducted.

The interviews were conducted with a translator who did not know the two *Kebele*s and could thus maintain a certain level of independence from the community members. Qualitative data was analysed using Atlas.ti. A pre-coding procedure was used to explore the factors that influence access control and/or access maintenance to the material and social components of the MBT package. A second coding was done to identify the underlying mechanisms that could explain why certain farmers had access control (or not) and/or access maintenance (or not).

4.4 The technology package and its introduction

The prescription

The MBT package is described in the Best Fit Practice Manual developed by the CASCAPE project (Abebe et al. 2015) and its main features can be summarised as follows:

- seed of a modern variety (Sabine or Traveler) sourced from a credible institution (malt barley cooperative or the regular extension system, but not via the market or self-saved);
- ploughing frequency (at least 3 times before planting and 1 time during row planting);
- row planting (spacing of 20 cm between rows and planting depth of 3-5 cm in rain-fed conditions);
- seeding rate (75-100 kg/ha);
- a fertiliser recommendation of 100 kg DAP and 50kg UREA per ha;
- weeding frequency (twice after planting, at specified periods), and;
- harvesting the barley when the grain moisture content is lower than 18%.

The description of this package was the entry-point for our analysis of the extent to which farmers complied or partially complied with these protocols. However, during the fieldwork, several other components were mentioned repeatedly by our respondents as indispensable components which they needed access to in order to apply the prescribed package. This made us realise that we needed to include additional components in our analysis. These included both material components (oxen, oxen plough, land, manpower, donkey cart) and social components (agronomic knowledge, marketing knowledge, being connected to the right people and cooperative membership).

Technology promotion in the Ethiopian context

Ethiopians are often referred to as ’the people of the plough’: more than 85 percent of the country’s population still lives in rural areas, where agriculture is the main economic activity (McCann 1995). The Ethiopian government has been prioritising investments in agricultural development, as exemplified by the Agricultural Development Led Industrialisation (ADLI) and the Plan for Accelerated and Sustained Development Programmes (PASDEP) in the nineties and early 2000s, and the subsequent Agricultural Transformation Plans (AGP I, II and III), and the Productive Safety Net Programmes (PSNP I-IV) which are currently being implemented throughout the country. These programmes have brought huge investments in the agricultural sector with an enormous increase in number of extension agents (called development agents) and farmer training centres, improvements in modern seed and fertiliser distribution, and more recently, agro-processing and market development (Oqubay 2017). Under different names and forms, a central component of these programmes has been the ’agricultural technology package approach’ (Ministry of Agriculture and Natural Resources Ethiopia 2017). In addition, Ethiopian agricultural programmes make use of the model-follower system: so-called model farmers are the first among the community to try out new best practices. They are seen by the *Kebele*s' administrations as role models who are expected to transfer their knowledge to their peers. While these approaches have been widely criticised for being top-down, technocratic and one-size fits all (Planel 2017; Teferi 2012), they have been reported to contribute to an annual increase in agricultural factor productivity of 2.3% over the past decade (IFAD 2016). In conjunction with this, numerous publications over the last two decades pointed to a strong entanglement of agricultural development, local politics and power dynamics (Berhanu and Poulton 2014; Lefort 2012; Teferi 2012). In Tigray for instance, local development officials have been appealing to institutions of the revolutionary past to mobilise smallholders, and to proclaim a refusal to adopt agricultural technologies as an act of dissent (similar to not taking part in the revolution during the Derg regime) (Segers et al. 2009). Planel (2017) by contrast, links agricultural development policies to the idea of *encadrement*, understood as the 'incorporation into structures of control', implying that the implementation of agricultural policies at the local level has the dual purpose of extending state control to the household level, as well as enrolling smallholders into development programmes in order to prevent future political unrest. In the literature we find accounts of the interface of politics, power and rural development in the regional states of Amhara (Lefort 2012; Teferi 2012), Tigray (Segers et al. 2009) and Oromiya (Emmenegger 2016). No equivalent in-depth case studies have been done in the SNNPR. In this respect, this case study adds a perspective of the local realities in a village in the Southern highlands.

In 2012 the CASCAPE project approached the administrations of the woreda (Malga) and *Kebele* (Guguma) to request their support for testing new varieties of malt barley which would be supplied by Kulumsa Agricultural Research Centre. CASCAPE was also practicing the model-follower system under the assumption that once model farmers applied for the MBT package, and sufficient quality seed was produced and made available through the seed cooperatives, the majority of farmers would follow the model farmers. In 2012-2013 the first on-farm trials took place on different farms in Guguma. Eight selected model farmers were the first to try the MBT package on their land. They received support from the CASCAPE project and extension system in terms of agronomic knowledge on how to multiply the malt barley seed (planting methods), the seed itself (variety Sabine) and the use of chemical fertiliser. Some farmers also received financial support to employ daily labourers to help the cultivation of the crop. The CASCAPE project also established a seed multiplication cooperative in Guguma, which was presented as an institutional innovation accompanying the agronomic innovation. The project also established a grain cooperative in Gomeshe-Tulu, which received significant support from the project: trainings on agronomy and cooperative management, networking support in terms of market linkages that were established between the cooperatives and Asella Malt Factory and a grant to construct a seed and grain storage facility and a seed cleaning machine (located in Guguma).

Practicing the Malt Barley Technology

According to our respondents, about 20% of households in the study *Kebele*s practice the full package, combining all the recommendations according to the MBT package as introduced by CASCAPE and the government. Although quite a few farmers mentioned (at public places or during interviews) that they fully comply with the package description, our own observations indicated that not all farmers who claimed to comply did actually apply the full package. For instance, some farmers did not practice row planting, deviated from the seed and/or fertiliser rate, or used farm-saved or market-purchased seed (rather than that supplied by the government). The most often mentioned reason for not applying the full package was because households were unable to access all the components. Land, oxen, manpower, seed, and fertiliser are scarce and many farmers face constraints in accessing these components of the technology (although some of these constraints are implicit rather than explicit).

The farmers who have started to grow malt barley – even if they only apply part of the package – are generally positive about the benefits. The most frequently mentioned benefits were improved clothing, food, livestock and housing conditions. All the respondents who applied the full package mentioned they had constructed a new (bigger) house and some had even constructed a house in town. Farmers also mentioned immaterial benefits. Some mentioned that they were able to pay for the higher education of their children. Additionally, compliance with the government's recommendations increases the status of farmers. Farmers with a long standing reputation of 'being serious', are also rewarded for openly complying with the extension system by getting new opportunities. One farmer said: *"If you perform well, you are asked to take on more and more responsibilities. I accept it because it is an honour to do these kind of* *things for the community." (Respondent 1, Male, Guguma, July 18, 2016).* However, some respondents also mentioned negative effects of applying (part of) the MBT package: they became indebted because they could not reimburse the credit they had taken to purchase the seed and fertiliser. This affected their social status, because it is socially unacceptable to be poor in the study communities. In line with this, these signs of non-adoption or 'refusal' are often interpreted by local officials and other community members as 'resisting development', as observed in other Ethiopian case studies (Emmenegger 2016; Segers et al. 2009; Teferi 2012).

On the basis of prescriptions for the package and interviews, we developed the following schematic depiction of the malt barley technology (Figure 16) showing the different material and social components that a farmer needs to access and the practices that farmers apply (or do not apply) as part of this technology. The arrows point to relations between a given component and practice.

The discrepancies between what farmers said publicly and during personal and/or informal interviews, motivated us to further explore the mechanisms underlying the lack of access. We explored access to the material components (land, seed, fertiliser, manpower, oxen, oxen plough) and how that access is interwoven with the social components of the technology (agronomic knowledge, marketing knowledge, being connected to the right people and cooperative membership).

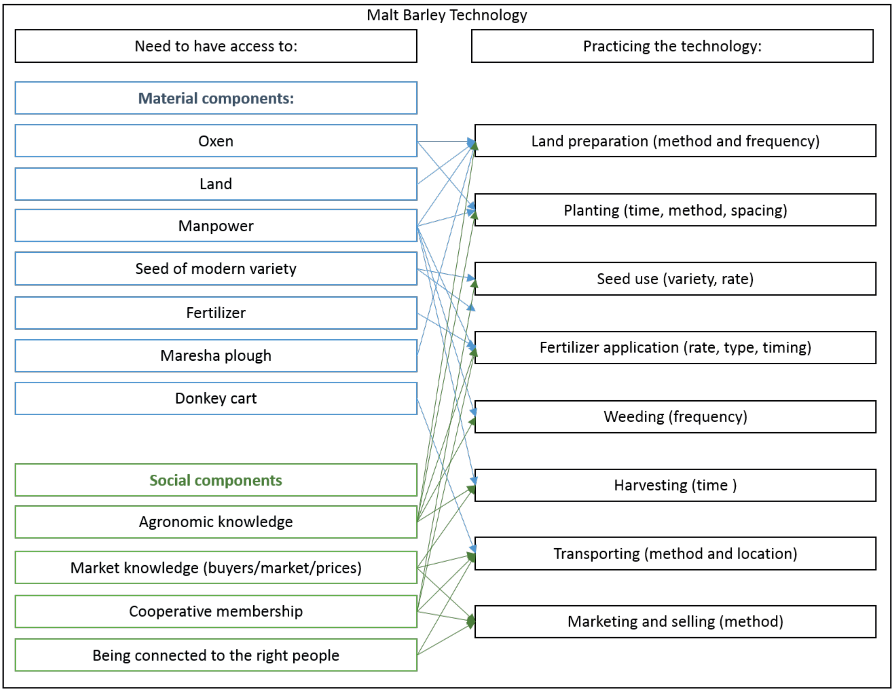

Figure 16 Components and their relations within the malt barley technology

4.5 Access to components of the technology

Access to material components

<u>Land</u>

In Ethiopia, land is owned by the government, not by the individual farmers. The Derg regime marked an important shift in land tenure. With the slogan ‘Land for the tillers, education for all’, land in rural areas was taken from the rich and redistributed to poor and/or landless people. Families that did not farm their land lost it to other families that needed farming land. The slogan ‘Land for the tillers’ remained an important pillar of land policy after the defeat of the Derg regime in 1991 (McCann 1995) although population increase in recent decades has resulted in households having smaller plots, a trend that also exists in in Guguma and Gomeshe-Tulu (source: personal communication with elderly farmer and *Kebele* Chairmen, 2016).

Our survey indicates that 43% of the households in the two *Kebele*s have secure access to 1 ha or less of farmland, generally perceived as too little to be a commercial farmer in Ethiopia (Samuel 2006). 42% of the households have access to 1-2 ha and only 15% has more than 2 ha[8]. Due to the clan-based inheritance system, young men born in large families from the Sidama and Oromo clans are likely to be land constrained. When brothers remain in rural areas the situation can be constraining, especially for the youngest. *"I only have a very small plot next to my house. That is not enough to plant malt barley. My father divided the land between me and my brothers. I am one of the younger ones in the family so I got a small plot." (Respondent 11, Male, Guguma, July 16, 2016).*

Most land is accessed directly, and can be seen as a form of access control. Acquiring access to extra land is possible through leasing land from others (i.e. indirectly). This is a normal practice for wealthier farmers. Poor farmers, and in particular female farmers who are head of a household, commonly lease-out their land. Sometimes they work on their leased-out land in return for cash or part of the harvest. At the intra-household level, young women can only access land through their husbands, brothers or fathers (i.e. access maintenance). Widowed women often retain control over the

[8] These averages are significantly higher than the reported average land size in the Southern Nations and Nationalities and Peoples Region of Ethiopia, which is estimated at 0.3 ha per household (Teshome 2014).

land of their deceased husband, but divorced women do not have this right under traditional customs. One woman described her way of maintaining her access to land as follows: *"The land is my husband's. But he has been sick for a long time now. I cultivate Qat and other cash crops. So far I have not been able to get hold of the inputs for malt barley. DAs don't like to work with women..." (Respondent 26, Female, Guguma, September 3, 2017).*

Households with limited land are often among the poorest in the community. Families who were historically disadvantaged face additional problems as they were not able to expand their asset base in the past. In Guguma and Gomeshe-Tulu a large portion of the households with very limited access to land prioritises growing food crops over cash crops and thus do not grow malt barley.

Manpower and oxen traction

The MBT package recommends ploughing the soil three to four times before planting, and a final time when planting. At the planting stage, rows of approximately 20 cm wide are created. The malt barley seeds are placed in the furrows, together with fertiliser. This is done as a team effort: one person ploughs the rows, while another sows the seed with the fertiliser. The timing is crucial: planting too late reduces the yield potential. To plough the soil, a pair of oxen are needed. Our data show that only 8% of the households in Guguma and Gomeshe-Tulu owns a pair of oxen; the remaining 92% of households have to rely on various exchange mechanisms to access oxen for ploughing. The extension system uses what is sometimes called 1-5 groups, which serve several purposes including neighbours sharing their oxen. These groups are set up by local government in parallel to the system of model-follower farmers. While the model-follower farmers set-up is not directly linked to the dominant political party, the 1-5 groups are linked to party membership. Several 1-5 groups (called cells) are gathered in larger groups, headed by members of the ruling political party. While the farmers say that it is in their culture to share oxen, not all farmers are satisfied with the oxen sharing system. One farmer told us: *"The problem is that I only have 1 ox, and I have to share mine with others and get one ox from others to plant in rows. That is the reason why I plant late." (respondent 11, Male, July 26, 2016).* Access to oxen has also consequences for applying the MBT package: *"Government people force people to plant in rows. But there is no-one in place afterward to support you. If you do not have oxen, how can you plant in rows?" (Respondent 6, Female, July 22, 2016).*

Poor households with small plots of land, in particular households with children too young to help much on the land, can find it difficult to produce enough to feed themselves. They have limited available manpower and limited financial means to purchase and maintain oxen. This means that they need to ask for support from others to be able to plough their land. Asking for support is seen as a sign of poverty and emphasizes their low social ranking. *"It brings shame on you when you have to beg for seed. People will not respect you, they will know you are very poor." (Respondent 18, Male, Gomeshe-Tulu, September 6, 2017).* This discourages many poor farmers from cultivating modern crop packages. Rather, these households engage in daily labour on other farms, or non-farm activities, to earn an income. The result is that those who generally find a way to access oxen (either direct or indirect) can take (full) advantage of the MBT package.

Seed and fertilisers

National extension policy dictates that at the beginning of each agricultural season, the DAs make an assessment of the amount of seed and fertiliser needed for their *Kebele*. As part of the woreda development plans, each *Kebele* also plans the amount of land to be planted with modern varieties and the expected yields. With the MBT package, the farmers had to indicate the amount of land they were planning to plant with the malt barley package. On the basis of these estimates and the recommended seed and fertiliser rate, the *Kebele* administration determined how much malt barley seed and fertiliser it would need and passed this information onto the woreda. This message was finally passed onto the federal level, where the Ministry of Agriculture was responsible for ensuring that the requested amounts of fertiliser and malt barley seed were distributed to the participating *Kebele*s before planting time. Fertilisers are generally distributed through the cooperative union or primary cooperative at *Kebele* level.

Quality seed for malt barley is scarce and it is problematic to arrange for its timely availability. DAs face the pressure of meeting their production targets for their *Kebele* (interviews with DAs in Guguma and Gomeshe-Tulu, 2017) and this leads them to tend to select households that they have confidence will be willing and financially able to purchase the recommended seed and fertiliser rates. This results in a selection process whereby certain households are more likely to access seed and fertiliser than others. A quote from a DA illustrates this point: *"The condition for receiving fertiliser is that you have to prepare your land well." (DA, Guguma, July 2017).* A farmer described problems faced by farmers in Guguma*: "First there are availability issues. The inputs are difficult to get. Seed and fertiliser are not available to all farmers. Seed is only available to members (of the cooperative). Others have to get it in the market. But in the market you don't know about the quality. And besides, it is not allowed to purchase seed at the market!" (Respondent 23, Male, Guguma, September 2, 2017).*

In Guguma, the President of the seed cooperative is also the President of the fertiliser union. In Gomeshe-Tulu the President of the grain cooperative is the former chairman of the *Kebele*. In both cases the presidents of the cooperatives are leading figures with a long record of holding influential positions. Since direct access to seed and fertiliser controlled by a small group of people, most households have to find indirect ways to access them. One farmer said that the DAs never visited his farm: "*I asked many times but they won't come. When I saw the malt barley in my neighbour's field, I became interested. I sold a calf and bought seed and fertiliser in the market." (Respondent 23, Male, Gomeshe-Tulu, September 10, 2017).* Another farmer stated: *"Through my friends I saw what I could do with malt barley on my land. I accessed the seed and fertiliser through the market." (Respondent 17, Male, Gomeshe-Tulu, September 6, 2017).* In the absence of direct access control, many farmers who want to apply the MBT package are obliged to purchase seeds and fertiliser on the market, a mechanism of access maintenance.

Access to social components

Agronomic knowledge

The DAs initially approach model farmers to share their agronomic knowledge on specific new technologies or practices. Although most interviewees said that they accessed agronomic knowledge on the MBT package through their fellow farmers (access maintenance), they did not experience accessing agronomic knowledge as problematic. In fact, even farmers who did not apply the MBT practices, were aware of the claimed advantages. Nearly all the farmers we interviewed had heard about the importance of row planting, weed management, and harvesting techniques, either during trainings, demonstrations, or via other farmers.

Cooperative membership and marketing knowledge

After the on-farm trials in Guguma in 2013, the *Kebele* administration organised a meeting to establish a new institution to organise seed multiplication for malt barley: the Derrera Seed Producer Primary Cooperative. They invited 21 male farmers to this meeting, who all became members. They received training on cooperative management and agronomic techniques as well as a grant to construct a seed storage facility. In subsequent years the cooperative expanded to 55 members, even though the membership fee increased from 500 to 2000 Birr. In 2015, in Gomeshe-Tulu a grain cooperative was established with 19 farmer members, which had expanded to 56 at the time of data collection (2017).

Members of the cooperative had a better chance of accessing seed through their own cooperative. In addition, membership of the cooperative provides the option to purchase seed and fertiliser on credit, without interest. Non-members can only make use of a credit arrangement if they are identified by the *Kebele* administration as poor, and even then the credit arrangement has an interest rate of 10-15% (personal communication with the Credit Manager of Gomeshe-Tulu, 2017). Thirdly, membership of the cooperative secures access to a buyer who purchases the harvested malt barley, for a premium price, reported to be 22% higher than that on the local market (Wageningen University and Research 2016). Thus, cooperative membership also guarantees access to a better and more secure market. Only 1 out of the 10 inhabitants in Guguma and Gomeshe-Tulu is a member of one of the two cooperatives (Malga Bureau of Agriculture, personal communication, September 2017). Those who are not members of one of the cooperatives face more difficulties in accessing the MTB inputs.

Being connected to the right people

In hindsight, the on-farm trials and subsequent meetings where membership of the cooperatives were determined (in Guguma in 2014 and in Gomeshe-Tulu in 2015) were crucial events because they created an exclusive and privileged situation for some households, increasing their ability to access improved seed (Sabine and Traveler), fertiliser (with interest free credit) and a secured buyer who guaranteed a premium price for harvested malt barley. However, regardless cooperative membership, being connected to the right people serves a purpose, as is clear from the following quote from a farmer: *"Only those farmers 'who are near to' can get inputs [...] from DAs. 'Being near' means having a good relationship with them,* *through your clan, and by living near the main road." (Respondent 18, Male, Gomeshe-Tulu, September 6, 2017).* Conversely, the people who are not well-connected to influential people face constraints, even if they manage to become cooperative members. As one farmer describe it: *"There are some problems with distribution. Some people get more benefits than others. Those who are distributing [the seed and fertiliser] give more to certain farmers and less or none at all to others. Or they sell it [i.e. fertiliser] to merchants." (Respondent 7, Male, Guguma, July 22, 2016).* It is apparent that 'being connected to the right people' was also an important pre-condition for becoming invited to become a cooperative member. On the positive side, having the 'right' social connections open doors to other components such as seed and fertiliser, markets and knowledge about other new innovations. But the reverse also holds true: those who lack those connections find their access to these components blocked, or at least more difficult. Being connected to the right people facilitated direct and indirect access to cooperative membership and markets.

4.6 Analysis of the underlying mechanisms

Farmers' experiences with accessing material and social components of the MBT, notably cooperative membership, credit, seed and fertiliser, were largely governed by their social relationships and their positions in the community. We identified three types of mechanisms that explain the dynamic process of accessing the material and social components of the MBT package: clan-based loyalty, vertical accountability and reciprocity. These mechanisms are related and partially overlap, and as we argue below, self-reinforcing.

Clan-based loyalty

While other in-depth case studies of agronomic extension in Ethiopia do not emphasise ethnic and/or clan based factors (Emmenegger 2016; Segers et al. 2009; Teferi 2012), we found that clan-based loyalty strongly influenced access to 'project membership' in our study areas. With clan we do not necessarily refer to ethnic groups, but rather to extended family clans within certain ethnic groups, which have existed in the study *Kebele*s. Most respondents said that clan was the most important criterion for receiving information from the DAs on agronomic novelties. *"Unless you have relatives from your clan in influential positions, there is no way that you can advance the situation of your family. We have tried many times to get involved in new initiatives. But our papers were not even considered" (Respondent 26, Female, Guguma, September 3, 2017).* In some cases, the clan-relation also affects the access to seed, as affirmed by this farmer who said: *"I never get seed directly from DAs, but mostly via my own friends or relatives." (Respondent 5, Male, Guguma, July 22, 2016)*

While clan-based loyalty was frequently mentioned by respondents who felt excluded by the extension system, this topic was not perceived as significant among those respondents who were in power (the *Kebele* administrators, DAs, etc.) or respondents from the dominant clan. Rather, this group referred to 'being serious' and 'hard working' as criteria for being invited to become a cooperative member, or for being selected as a host farmer for on-farm trials. This difference seems to indicate that clan-based loyalty is a mechanism which – covertly– influences access, although it is not accepted to talk openly about this topic - as it does not fit the extension narrative, which is based on the ethos of being hard-working and leading by example. Farmers spoke of several strategies that are used by others to improve their connection to clans that are considered to have substantial power: *"It is very common in this area to marry with the purpose of getting closer ties with those in power (mengist) to improve your livelihood. I don't want to give examples, but believe me, it is very well known." (Respondent 22, Male, Gomeshe-Tulu, September 7, 2017).*

Vertical accountability

The second mechanism can be characterised as vertical accountability, from community members to DAs, and from DAs to their superiors. Local authorities perceive themselves to be under pressure to demonstrate positive results (in terms of the volume of cereals produced with use of modern seed, chemical fertilisers and modern agronomic practices, such as row planting). This leads DAs to select farmers who have a reputation for producing these results. For instance, all respondents mentioned that the farmers who were the first to access the MBT package were farmers with a reputation of being serious farmers, who were wealthy enough to invest and assure a good harvest. The *Kebele* manager of Guguma confirmed this: *"I was responsible for the farmer selection. We informed only 21 farmers, whom we were certain would be able to pay the fee and who would be interested. We guessed that most farmers would not be ready to take the bet and pay 250 Birr in advance for something they were not sure about. The 21 are well-known from other experiences." (Kebele manager, Guguma, September 9, 2017).*

The following quote shows the other side of the coin whereby farmers who cannot (or do not) comply with the government's expectations are disrespected: *"If poor farmers don't show they adopt the row planting methods, they will be disregarded by the whole community. They will not be respected. They will never be selected for any kind of other support. So they have no choice but to struggle! Social exclusion is not the way you want to go." (Respondent 27, Male, Guguma, September 4, 2017).*

Many farmers experienced pressure to follow the recommendations from the extension agents, partly as a pre-condition for accessing seed and fertiliser: *"The condition to receive fertiliser is that you have to prepare your land well." (Kebele administration, Guguma, July 2017).* But even when these inputs are accessed, the pressure to follow the DA's recommendations continued. At one point during the field work in 2016 some model farmers were mobilised because there was a rumour that an official delegation of regional administrators would visit Guguma. The DA visited several model farmers and instructed them what to say and what to do if this delegation visited their farm. Some farmers protested as they were not willing to exaggerate the amounts of seed and fertiliser that they planted on their land or were not willing to praise the local authorities. Others were more willing to comply with this request: *"We have to give up our time for these visitors. They come and order us to do things. Why? I was standing next to my husband when he repeated exactly what he was supposed to say, without blinking. I was laughing at him a lot!" (Respondent 28, Guguma, July 2016).* We also observed that farmers actively engage in relationship-building with the local authorities. This became visible through three related strategies: public praising the local authorities, public compliance with the government's recommendations and 'being around'. One farmer clearly described how he considers praising the local authorities as a gateway to become part of the group of farmers who 'get given chances': *"I was not selected. But the barley package is amazing! If I show my good will and if I am able to convince the DA that I am a serious farmer, I will hopefully get a chance soon." (Respondent 17, Gomeshe-Tulu, September 6, 2017).* Even though this farmer was excluded by the extension system in the beginning, he refuses to speak badly about them. During the interview it became clear that he was convinced that being positive and building a good relationship with agents of the local authorities will be beneficial in the future. In line with this, respondents also mentioned that having the reputation of being a serious and hard-working farmer is advantageous because it increases the likelihood of accessing benefits from the local authorities in the future. This analysis is closely in line with the findings of Planel (2017) who mentions that farmers are consciously busy with 'keeping up appearances' when being among local government officials (or their representatives). While farmers who already have good connections, continue to demonstrate their good will through complying with the requirements of the government, as is shown in the following quote: *"To become a member of the cooperative, you have to show that you prepare your land very well (i.e. plough your land many times, and not work on other farmers' land); you have to participate in many governmental meetings; you have to convince others that this technology is very good; you have to be able to pay the membership fee; you have to have a large land size (2 ha) so that you can produce* *a lot of malt barley. If you want to become a member you have to ask the DAs to visit your farm." (Respondent 24, Male, Guguma, September 2, 2017).* This shows the vertical accountability whereby both farmers and DAs need each other to perform in certain ways to be able to remain (or improve) their situation.

'Being around' is a social connotation for showing up to meetings, showing your face on market days, and for making yourself seen by the *Kebele* administrators and DAs: *"You have to spend much time with DAs, invite them for coffee, tea, lunch, you have to talk to them. You have to participate in many of the meetings so that they start to know you. If you spend a lot of time in 'the centre of the road', there is a chance that they will see you. Then you can talk to them and they might tell you [about new opportunities]." (Respondent 22, Male, Gomeshe-Tulu, September 9, 2017).* Being around does not guarantee direct access to inputs, but being known by DAs, the *Kebele* manager and the cooperative management, gives one a privileged position when seed and fertiliser are distributed. Implicitly most interviewees mentioned that a 'serious farmer' is able to build relationships with the authorities. Conversely, farmers who are not able to do this, mention that they are, or cannot, 'be around'. *"In the beginning I was not around. I only realised later how important it was to become a member [of the cooperative]. I regret that I did not work harder back then, to get involved. They put a hold on membership so it is not possible to join anymore." (Respondent 27, Male, Guguma, September 4, 2017).* While 'being around' is possible for households with enough resources to hire manpower for the daily work, it is harder for poor families who rely on selling their manpower to be present at such meetings and on market days: *"You have to spend* *much time with them. But if you are sick or you work on other people's farm, you don't have time for all these social events. People do not regard me as important because I don't show up." (Respondent 28, Male, Gomeshe-Tulu, September 4, 2017).*

These findings on vertical accountability fit other recent studies on the Ethiopian extension system, which point to an Ethiopian state that mobilises local authorities and rural elites through the extension system by enforcing accountability and reward systems that extend to the lowest possible administrative level. The active and continuous engagement of farmers in social-relation building is a mechanism of access maintenance.

Reciprocity between farmers

Reciprocal arrangements between farmers are the third type of mechanism that influence access to certain components of the MBT package. While reciprocity is often depicted as something positive for everyone, this case study shows that reciprocal arrangements between farmers can work out differently for farmers from different socio-economic and gender categories. This was most strongly visible in the case of oxen sharing. While used by the extension agents as 'social asset' in farming communities, in reality oxen sharing practices are socially-bounded. In other words, the reciprocity is not on equal terms and not everyone equally benefits from these practices. Only a small portion of the households (8%) own 2 oxen and are able to plough their land when they want. 12% of households have 1 ox. If they have neighbours with another ox and they have a good relationship, it is common for them to share their oxen and plough their land together. However, families with no oxen (80% of the community) have to wait until the others are done with ploughing before they can request to use oxen in return for their manpower. Hence, wealth causes a differentiation between those who can plough when they want, and those who depend on others to plough their land. Additionally, women are not seen as ’real’ farmers, and are not considered to be in need of oxen. Women who do not have oxen and want to cultivate their land face serious constraints in accessing oxen.

Besides oxen sharing, another reciprocal system is labour sharing during planting and harvesting time. When probing further on this topic, it became clear that labour sharing is less common than oxen sharing. Most households in the study areas, poor as well as wealthier, prefer to pay for manpower rather than to exchange labour. Selling manpower is an accepted strategy for poor households to acquire an income. However, on the other hand, working (for payment) on other people’s farm is seen by wealthier farmers as a sign of poverty, which decreases one’s status in the community. Furthermore, being poor is associated with being lazy, pathetic, and other negative associations. *“Farmers who work on others’ land, are not regarded as good farmers by the community. The community does not accept these kind of farmers as serious because they don’t farm their own land...” (Elderly, Male, Guguma, September 2, 2017).* It is socially unacceptable to ask directly for support, without returning either labour, oxen, or something else. Farmers who do so, demonstrate their poverty. This is generally considered as something bad in the community, as the following quote demonstrates: *“I don’t ask others for help. Nobody would do that here. It brings shame on you when you have to beg [for seed].*

People will not respect you, they will know you are very poor." (Respondent 18, Male, Gomeshe-Tulu, September 6, 2017).

So, while reciprocal arrangements are mentioned publicly as a commonly accepted mechanism for accessing oxen and labour, there are barely disguised social factors that influence who gets to access and offer manpower and oxen and who is excluded. A similar pattern was found in a study on seed exchange mechanisms in Ethiopia conducted by McGuire (2008), which brought to the fore that local community support mechanisms are not as generous or unconditional as they might appear to outsiders. For instance, asking for help without providing anything in return stands for poverty, which in turn is associated with being lazy and not serious. Farmers who are unable to farm their own land are also considered to be 'bad' farmers. These examples are in line with the findings of Segers (2009) on the political dimensions of development in Tigray with signs of non-adoption of modern technologies often being interpreted by the government and elite farmers as acts of rebellion against the ruling political party. Although in this case study no such remarks were made by local authorities, the underlying thinking is that you have to – at least publicly – praise the efforts of the government and play along with the rhetoric that technologies are good and farmers who cannot adopt those technologies are either lazy or rebellious. While accessing manpower and oxen are not as straightforward as one might expect, the effects of non-access are that certain farmers are excluded from the community because they are regarded as lazy or rebellious (or both).

Mutually reinforcing mechanisms of inclusion and exclusion

In Guguma and Gomeshe-Tulu, clan-based loyalism, vertical accountability and reciprocity seem to be self-reinforcing mechanisms of inclusion and exclusion. On the one hand, 'insider' farmers have better access to components of the technology, as well as other new opportunities, which reinforces their social and economic status in the community, which further reinforces their attractiveness to be targeted by the extension system as model farmers. *"If you perform well, you are asked to take on more and more responsibilities. I accept these because it is an honour to do these kind of things for the community." (Respondent 1, Male, Guguma, July 18, 2016).* However, there is also a lot of envy and jealousy among households who are not part of this small group of 'chosen ones': *"Model farmers keep the benefits to themselves. They might tell you about row planting, but that's it. These days they seem to have become more self-centred. I think it is because they have got richer and want to protect what they have" (Respondent 28, Male, Gomeshe-Tulu, September 4, 2017).* The other side of the coin is that once you are perceived by the community as being poor or lazy (often mentioned in the same breathe), it is difficult to change this reputation. DAs are not interested in visiting farmers with a 'bad' reputation, thus they get ignored by the extension system, which in turn increases the difficulties in accessing the necessary components to apply a new and promising technology.

4.7 Discussion

Adoption as a negotiated and layered process of accessing

This paper contributes to academic endeavours to find more nuanced ways to conceptualise the processes of adoption and scaling. The findings of our study are in line with earlier refinements of these concepts, which suggest that it is useful to look at the scaling of practices and use of artefacts in relation to other (technical and social) practices and components, including those that form part of the 'enabling environment'. Such practices and components are clearly visible in the case of MBT, but they also stretch well beyond the technology package provided by the project (section 4.1). Our case study of MBT underlines (once more) that scaling and adoption are not simply the result of individual farmers' decisions, but arise from a web of interactions that exist within and beyond farming communities. The findings highlight an often ignored aspect of such interactions, related to how people access the components of an innovation package, including knowledge, inputs and connections. In doing so, we have applied insights on access developed in the domain of natural resource management. The frameworks that we have discussed earlier (Berry 1989; Milgroom 2012; Ribot and Peluso 2003) proved highly relevant to our analysis of AR4D initiatives and helped us to broaden our understanding of how the uptake of technology is affected by socio-political dynamics.

In our case study the distinction between access control and access maintenance developed by Ribot and Peluso (2003) proved very useful in terms of material resources, such as land, oxen, seed, fertiliser and manpower. On the surface, it seemed possible to distinguish between controlling the resource (e.g. who decides over the use of land or manpower) and accessing the resource through others (access maintenance) via reciprocal arrangements such as oxen and labour sharing. However, when analysing the social components, such as agronomic knowledge, markets, and cooperative membership, the distinction between access control and maintenance was less obvious, since these components are relational by nature, implying that access to social components is always negotiated and never controlled just by one actor.

Scaling the technology or scaling exclusion?

We identified three underlying mechanisms that played an important role in shaping access to the MBT: clan-based loyalty, vertical accountability and reciprocity. These mechanisms are often invisible but still very important in governing the terms of access to material and social resources and technology in rural communities. The external AR4D project in this case study (CASCAPE) was not able to eliminate these mechanisms and their effects. Indeed, the project did not attempt to change the existing 'social rules of the game' that govern access but accepted them for what they were. As a result it actually reinforced the adverse effects of these mechanisms. Our case shows that chronically poor people were severely frustrated in their capacity to exercise agency. Because of their constraints in accessing land and oxen, they worked on other farmers' farms and could not invest the time required to show up at meetings and bonding with more influential farmers and DAs. In return, because they don't farm their own farm (or it is very small), these poor farmers are disregarded by the community as being not serious, excluding them from new opportunities and thus widening the gap with their wealthier peers. This confirms the findings of Cleaver (2005) that the social conventions that communities have established over time, i.e. the ’‘right ways’ of socialising, associating, and participating in public life, tend to reinforce existing relations of authority, which channel everyday actions to reproduce such social structures. While the mechanisms of exclusion were most apparent for the poorest of the poor, these mechanisms also caused exclusion of other categories of farmers (women in particular, but also farmers who were historically disadvantaged by their original clan and, lastly, farmers who simply did not have the right connections to become invited to the cooperative from the start).

The findings from this case study of two highland villages in the south of Ethiopia support earlier studies with respect to the observation that the current Ethiopian extension system works to expand state control to rural communities (Emmenegger 2016; Lefort 2012; Planel 2017; Segers et al. 2009; Teferi 2012). As such, this case study does not stand in isolation but is a confirmation of the picture of a strong entanglement of politics, power, and agricultural development in which development money is used to maintain or expand the authorities control over rural households. Our findings add to earlier studies by showing how socially constructed mechanisms of accessing modern agricultural technologies can reinforce existing poverty dynamics. By ignoring this socio-political context, the malt barley intervention has probably resulted in an unintended ‘negative scaling’ effect: a widening of the social and economic gap between a few better off farmers and a larger group of poor farmers. It thus seems that instead of scaling the technology the project unintentionally scaled a process of social exclusion.

Implications for policy and practice

Based on our work in Guguma and Gomeshe-Tulu, we reiterate the conclusion of Cleaver (2005) that to avoid social exclusion of the poor we need to consider their structural disadvantages and constrained agency. AR4D projects intervening in areas where poverty prevails can basically choose between two directions: 1) acknowledging that they may not be able to serve the poorest-of-the-poor directly and target their efforts and resources to the 'economically viable poor', or 2) consciously addressing poverty in its wider socio-political context. This second option requires moving away from a narrow frame of a technical fix in assumedly static communities, towards acknowledging that agricultural innovations are always socio-technical/material in nature. Practically, this implies that AR4RD should pay more attention to how different categories of households can overcome the obstacles to accessing new technologies. This involves understanding the social mechanisms that affect access control and maintenance in the communities where technologies are being introduced or scaled. If the socio-economic context had been taken into account from the start, issues such as land shortage, limited availability of oxen and financial capital might have given rise to innovations in which access to land or other forms of capital were less of a pre-condition (e.g. small ruminants or beekeeping, processing and small scale mechanisation). Concretely, in the case of Guguma and Gomeshe-Tulu, more attention could have been paid to 1) experimenting with alternative labour and oxen exchange mechanisms to make these accessible for a wider group of households; 2) providing micro-credit facilities to poor households; 3) introducing new technologies for land constrained households. Furthermore, awareness of the exclusive character of the fertiliser union and seed/grain cooperative could have helped to increase the widespread application of the MBT package.

The finding that knowledge was not a limiting factor in accessing the new technology was remarkable: all members of the community to whom we spoke were aware of the different agronomic practices of the MBT package and their benefits. The limiting factor was socially constructed, namely ’being connected to the right people’ to benefit from this knowledge. Here, our case study contradicts the commonly held assumption that the diffusion of agronomic knowledge drives adoption of modern agricultural technologies (Feder and Savastano 2006; Rogers 2003). Our findings are more in line with those of Cheesman and his colleagues, who reported that the closure of knowledge gaps in Zimbabwe did not automatically result in the adoption of conservation agriculture technologies (Cheesman et al. 2017).

The findings of this case study are also relevant for agricultural extension policy makers and practitioners who predominantly focus their attention and efforts on disseminating technical knowledge. Access to other material and social components of agricultural technologies, such as improving linkages to input and output markets or credit facilities, or the political system, are often considered as contextual factors that are beyond their responsibility. Hence, our study supports earlier calls for rethinking extension and extension

4

policy (Dormon et al. 2007; Leeuwis and van den Ban 2007). Taking the different (and often invisible) social aspects of 'access' into account within AR4D will entail a reorganisation of the research – extension – continuum. In this case study the introduction of the MTB package involved considerable social engineering: the establishment of two cooperatives which resulted in access control for 'included' farmers, while creating obstacles to access for those not included. Some of these obstacles that this created could have been overcome by establishing access maintenance mechanisms (relationship building with influential persons), but even this requires access to resources which not all farmers have access to. Hence, scaling of a technology package also requires scaling of socially engineered mechanisms to enable farmers of different socio-economic categories to access components of the technology package. This could mean the creation and scaling of credit institutions or scaling the reconfiguring of reciprocal arrangements between farmers. Engagement in social engineering may seem beyond the remit of organisations involved in AR4D (although in this case study there was social engineering, the consequences of which were not perhaps fully thought through). However if they, and their donors, aim to improve livelihoods of the poorest of the poor, it is crucial to acknowledge the underlying social and political causes of persistent poverty in poor rural areas. Ignoring this context only results in perpetuating and perhaps even reinforcing the status quo. Alternatively, AR4D could more honestly or explicitly acknowledge its limited capacity to help all types of farmers and that the poorest of the poor may not be a feasible target group.

Concluding remarks

Our case-study demonstrates how an external intervention aiming to provide access to a modern agricultural technology of malt barley was affected by the social-political dynamics of access. These dynamics effectively turned the attempt to scale modern technologies to the scaling of exclusion of some community members. This suggests that attempts to create an enabling environment for technology uptake through the provision of access to agronomic knowledge and inputs is simplistic since it ignores the deeply entrenched dynamics within, and around, the communities of prospective beneficiaries. At the same time it demonstrates, at the conceptual level, that the processes of accessing profoundly influence scaling, which adds to the difficulty AR4D achieving its intended impacts. One could argue that this case study has limited external validity as it is based on a single case study at the interface between an external AR4D intervention and two rural communities in southern Ethiopia. However, the findings of the study show that technologies and the way that external agencies seek to introduce and to scale them are far from neutral. We encourage other researchers to critically assess the validity of this case study by applying it to other domains (such as agriculture-nutrition linkages) and /or other geographic areas.

Chapter 5

Opinion Leadership under Imperfect Market Conditions: the Case of Malt Barley Technology in South Ethiopia

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Abstract

Purpose

Agricultural extension services in poor countries often identify opinion leaders based on pre-set criteria such as wealth, social status and education level. In this paper we explore the effectiveness of this top-down approach by analysing the role of so-called model and nodal farmers in the diffusion of the malt barley technology in a highland community in Ethiopia.

Research approach

We use a retrospective case study design in which we combine quantitative network analysis with qualitative data to understand the role of two types of opinion leaders during the introduction of the malt barley technology.

Findings

Our findings show that nodal farmers played a more central role in knowledge diffusion of the technology than model farmers. While model farmers were wealthier and better connected to the local authorities, nodal farmers were socio-economically more similar to their fellow farmers and often occupied informal positions. Both nodal and model farmers, as well as farmers closely connected to either of these categories, had a significantly higher adoption index than the rest.

Practical implications

While diffusion of knowledge is an important condition for the widespread adoption of modern agricultural technologies, it is not enough, particularly when access to external inputs is limited. Moreover, relying on assumed opinion leaders has its limitations and may even reinforce existing inequalities. We propose further research on complementary approaches such as social network analysis to identify community brokers who emerge from bottom-up.

Originality

Our combined research approach differs from the mainstream of studies in this field that employ either ethnographic fieldwork or (spatial-)econometric methods. With this approach we aim to create a bridge between the often separated worlds of (technical) agronomic research for development, (qualitative) rural sociology, and (quantitative) econometric and network analysis.

Key Words

Opinion leadership, social networks, agricultural technologies, Ethiopia.

Paper type

Research paper

5.1 Introduction

The role of opinion leadership in the diffusion of innovations

The process of innovation is often thought to be initiated or supported by opinion leaders, who have the ability to influence others' attitudes and knowledge (Feder and Savastano 2006). Agriculture extension methods are heavily influenced by the seminal work of Rogers, who states that opinion leaders have the following characteristics in common: greater exposure to media; more cosmopolitan; more contact with change agents; greater social participation; higher socio-economic status; more innovative and moral authority (Rogers 2003, p.316–319). Many agricultural research for development (AR4D) initiatives in Low and Middle Income Countries (LMICs) work with the so-called model farmers approach, reasoning that when appointed opinion leaders are satisfied with a new technology, others will follow them sooner or later. While there has been much research done on the effectiveness of the model approach in health care (van Griensven et al. 2007; Valente and Davis 1999), there is limited empirical research on the effectiveness of this approach in disseminating agricultural technologies in LMICs.

Opinion leaders can emerge in diverse ways (Bamakan et al. 2019; Valente and Davis 1999), for instance from within rural communities, without being formally appointed by any authority or organisation (Valente and Davis 1999). A study on the diffusion of microfinance in India found that the centrality of local actors such as shop keepers, input suppliers and village heads constituted a strong predictor of eventual village-level participation in microfinance (Banerjee et al. 2013).

The lion's share of literature uses the individual characteristics of opinion leaders as a proxy for the ability of opinion leaders to influence others. However, there has been limited field research done to explore whether people with the individual characteristics of opinion leaders (as identified by Rogers) do indeed (1) have a wide social network and (2) share their knowledge with others. Social network theory provides a useful perspective for studying this. For instance, a network analysis on the diffusion of integrated pest management practices in an Indian village found that a small group of brokers was able to bridge between homogeneous caste groups and other actors such as the NGO that introduced the practices (Arora 2012, chapter 8). Thus, next to individual characteristics, the effectiveness of opinion leadership may also depend on the composition of and pre-existing social relations in the community in question.

5

Problem statement

This research explores the role of opinion leaders in the diffusion of the malt barley technology in a highland community in South Ethiopia that is characterised by constraints in information availability (de Roo et al. 2019; Leta et al. 2018) and imperfect input and output markets. The two research questions are: (1) to what extent are appointed model farmers better than others in sharing knowledge about improved agricultural technologies? And, (2) to what extent does connectedness to knowledge sources result in a higher uptake of improved technologies?

Both questions will be addressed in the specific context of information asymmetry and imperfect input and output markets. Many smallholder farmers in LMICs countries have limited access to information about technologies and how they perform on-farm (Conley and Udry 2001), partly because governments in these countries have limited resources for public extension services (Swanson 2008). In addition, low mobility and lack of media exposure limit farmers' options to identify new technologies, implying that farmers heavily rely on their social networks for information. Little empirical research has been undertaken to explore the role of opinion leaders under conditions of information asymmetry. It could be argued that their role becomes more important when information is harder to come by, because they may act as 'gatekeepers' and disseminate information to certain people and not to others. On the other hand, one could also argue that in such contexts information from opinion leaders has limited reach.

Imperfect input and output markets refers to the scarcity of inputs and limited market access for individual smallholders and is a common phenomenon in many LMICs (Jack 2011; Katungi et al. 2011), Ethiopia included (Asfaw et al. 2011; Byerlee et al. 2007; Yu et al. 2011). Earlier research in our study area indicates that having a strong social network facilitates access to inputs, although it is not clear how opinion leadership affects access to inputs in such conditions.

In the following section we describe our materials and methods. Thereafter we present the empirical findings, followed by a discussion and conclusions.

5.2 Materials and Methods

Research approach

We use a retrospective case study design (Yin 2009), in which we combine quantitative network analysis with qualitative data to understand the role of two types of opinion leaders during the introduction of the MBT in the study site. Our approach differs from the mainstream of studies in this field, which employ either ethnographic fieldwork or (spatial-) econometric methods. We aim to bridge the often separated worlds of (technical) agronomic research for development, (qualitative) rural sociology, and (quantitative) econometric and network analysis by using a combined approach.

We employ a social network approach to identify who shares knowledge with who in the study area, In social network theory, farmers are considered nodes, and the talks (knowledge exchange) between farmers are the connections between them. We follow the approach developed by Borgatti (2005) on network measures and take eigenvector centrality (Bonacich 1987) as measure for the importance of nodes in the social network. Eigenvector centrality is not simply the total degree (sum of all connections, this is called 'centrality'), but the *weighted* sum of connections of a node: each connection's weight is determined by its own eigenvector centrality (Beaman et al. 2018). The idea behind eigenvector centrality is as follows. Even if node 'A' connects with just one other node 'B' in a network, if node 'B' subsequently connects with many other nodes (who themselves connect again with more others), then node 'A' can be regarded as highly influential in that community (Borgatti 2005, p.61). In our case we use a direct network approach, whereby we identify knowledge flows between farmers. In such networks, basically three types of degrees exist: total degree (sum of all connections of a node, also called centrality), in-degree (number of nodes that mention the respective node as source of knowledge) and out-degree (number of nodes mentioned by a node with whom knowledge is shared).

Potential Opinion Leadership: Model Farmers and Nodal Farmers

In this paper we compare two categories of potential opinion leaders: model farmers and nodal farmers. The Ethiopian extension programme employs the model farmer approach whereby certain farmers are appointed to try out new technologies and best practices first (Ministry of Agriculture and Natural Resources Ethiopia and ATA 2014). They are seen as exemplary farmers who are expected to transfer their knowledge to their fellow farmers (five 'followers' for each model farmer). Model farmers are often (but not always) appointed as host farmers for demonstration trials. We contrast this group with 'nodal farmers'; farmers from within the community who play an important role in knowledge exchange, as expressed in their high eigenvector centrality (Table 10).

Study site and the technology

The malt barley technology package (MBT) consists of seed of an improved variety from a trustworthy source, fertiliser recommendation, and improved agronomic practices such as ploughing (a minimum of three times before planting), row planting, and hand weeding (three times). The MBT was introduced in 2012 in Guguma, a highland *Kebele*[9] in Melga woreda, in Sidama Zone, in the South of Ethiopia (Figure 17). The livelihoods of the majority of inhabitants in Guguma are based on a mixture of agricultural activities such as the production of cereals, enset, pulses and livestock (Abebe et al. 2015). For more background on the

[9] *Kebele* is the lowest administrative unit in the Ethiopian government structure.

introduction of the MBT in Guguma we draw on our earlier research (de Roo et al. 2019).

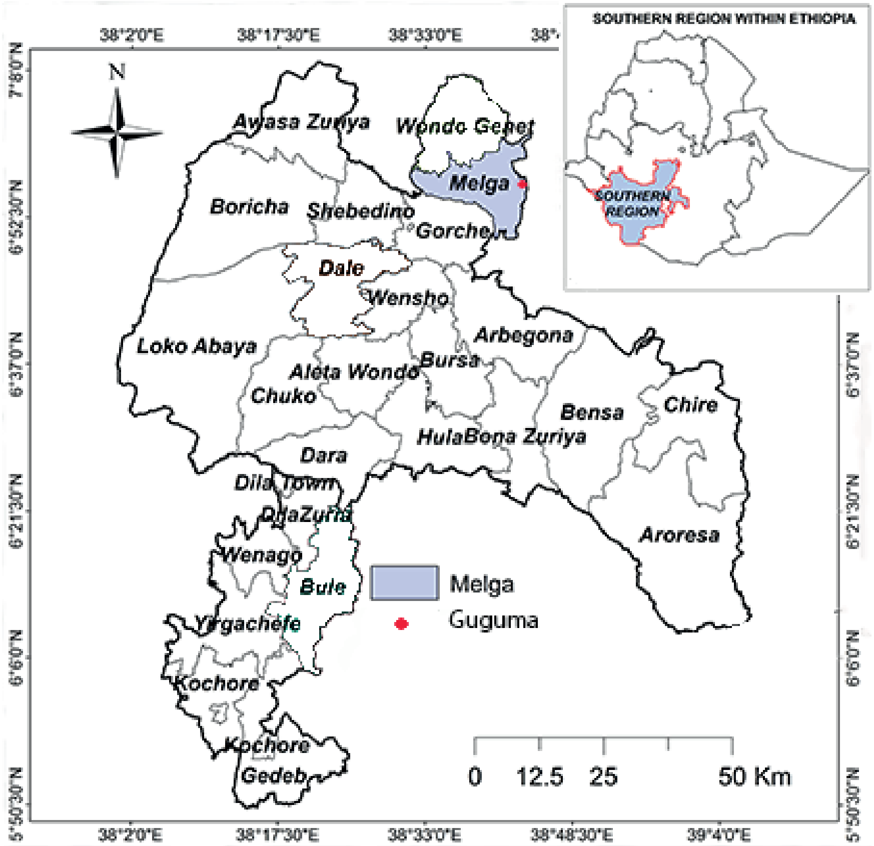

Figure 17 Map of the study area
Source: adapted from Mellisse et al. (2017).

For pragmatic reasons we define adoption of the MBT as the extent to which respondents apply components of the MBT on their farm at a given time. We realise that this is a limited view, and that the wider uptake of the MBT requires a reconfiguration of socio-technical and institutional components in the system, such as making seed and fertiliser available on time, ensuring market access, and removing bottlenecks such as the scarcity of labour and oxen (de Roo et al. 2019). Based on earlier research in Ethiopia (Asfaw et al. 2011; Croppenstedt et al. 2003; de Roo et al. 2019), we argue that inputs are a critical constraint for the wide-scale uptake of modern agricultural technologies. Given this constraint, we will assess whether farmers who are appointed by the extension system as model farmers are significantly more likely than nodal farmers or other farmers to apply external inputs on their farm . In Annex II we define the variables used in this analysis.

Data Collection and Analysis Techniques

We first present the network data, collected in 2017. Given the network character of our research, we used a snowball strategy to sample respondents. We started by asking the Head of Extension in Guguma to identify five farmers he considered to be most influential in sharing knowledge of new agricultural technologies. By following a snowball technique eventually arrived at a sample of 65 farmers[10]. We also collected details about the farmers' socio-economic characteristics, membership of formal and informal groups and political and religious organisations, and their uptake of the MBT. Because this research was part of the Dutch funded CASCAPE programme[11], we had access to quantitative data of another 65 farmers in the same *Kebele*. This second sample was randomly selected from a list of the households obtained from the *Kebele*

[10] We interviewed the persons mentioned by the extension head (n=5), and asked them "since the introduction of malt barley in this community, to whom in this community did you provide knowledge about malt barley?" Conversely, "From who in this community did you receive knowledge about the malt barley technology?" From the total number of persons that the farmer referred to, we followed up on the first five reported names. Next, we visited these five farmers and asked the same questions. We continued this exercise until we had a sample of 65 farmers.

[11] CASCAPE stand for Capacity building for scaling up of evidence based best practices in Ethiopia

administration. Due to data entering errors and overlap in the two samples, we only used the data of 115 of the 130 farmers, approximately 10 percent of the total population of Guguma.

Since we found no statistically significant difference between the snowball and random sample for key variables such as land size, uptake of the malt barley package, education level, social status and asset base[12], we combined the two samples for further analysis.

We established a category of model farmers (n=38). Next, we selected the 38 farmers with the highest eigenvector centrality; our nodal farmers. Sixteen farmers fell into both categories. To reduce this overlap, we randomly selected seven respondents who were both model and nodal farmers and deleted them from the sample; removing more farmers from the analysis would have resulted in too few farmers in each category to conduct statistical tests. The total sample for further analysis thus consisted of 108 farmers: 31 model farmers and 31 nodal farmers, with nine farmers belonging to both categories. We compared model farmers with the rest and we compared nodal farmers with the rest; in both cases the rest was a sample of 77 farmers (Table 7).

Table 7 Categories of farmers used in this paper

Category	*Definition*	*Size*
Model farmer	The respondent was identified as a model farmer in 2016 by the extension system.	n=31
Nodal farmer	The 33.3% respondents with the highest eigenvector centrality.	n=31
The rest category	When comparing nodal farmers with the rest, the rest consist of model farmers and ordinary farmers.	n=77
	When comparing model farmers with the rest, the rest consist of nodal farmers and ordinary farmers.	

[12] The output is available on a server hosted by WUR. Request for access to the raw data and analysis output will be given upon request; please contact the corresponding author at nina.deroo@wur.nl.

Besides quantitative network data we also collected qualitative data from participant observation and semi-structured interviews during two periods of fieldwork in July-August 2016 and August-September 2017. We interviewed a Development Agent (DA), the Head of Extension at the *Kebele* level, a village elder, and the *Kebele* manager (four structured in-depth interviews) and did semi-structured interviews with 17 households (five model farmers, five nodal farmers and seven ordinary farmers).

Data Analysis

Statistical analysis of quantitative data was done with SPSS version 25. Since the data was not normally distributed[13], we proceeded with non-parametric statistical tests. We mostly used the chi-square test to understand the commonalities and differences between model farmers, nodal farmers, and the rest. For categorical variables (such as education level) we used the Mann-Whitney test and for continuous variables (such as the adoption index) we conducted an independent samples t-test (Field 2013). For the visualisation of network data and calculation of eigenvector values we used Gephi 9.2. For the analysis qualitative data we used Atlas.ti. We first coded the qualitative data inductively. After this first round of coding, a set of codes emerged related to mechanisms that influence access to components of the malt barley package. The interviews were then re-coded deductively and analysed accordingly.

[13] This was found with the Shapiro Wilt test for continuous variables. The output is available on a server hosted by WUR. Request for access to the raw data and analysis output will be given upon request; please contact the corresponding author at nina.deroo@wur.nl.

5.3 Results

Knowledge Networks in Guguma

In a situation of perfect information symmetry, the model farmer approach would ensure that knowledge reaches all farmers in the network via a hierarchical structure (Figure 18a): each model farmer (M) would share his or her knowledge with five other farmers (F1), who in turn share this knowledge with five other farmers (F2), who also share their knowledge with five other farmers (F3). Figure 18b shows the empirical data of our network analysis (n=108) whereby the size of the nodes indicates the eigenvector centrality. Our presentation of the network places farmers with many connections in common close to each other, rather than representing physical distance. Knowledge flows well within clusters, but less easily between clusters. Figure 18b shows the presence of structural holes: the white spaces next to, and between, hot spots of nodes close to each other. The smallest nodes represent farmers who shared knowledge on malt barley with no-one or just one other farmer; they can be assumed to play an insignificant role in terms of knowledge dissemination. Figure 18b also shows that the knowledge did not diffuse exactly according to the model-follower system, although most model farmers do share knowledge with a few others. The presence of quite a few big sized black nodes, suggests some other farmers share knowledge with more farmers than model farmers do. We analyse this further in the next section.

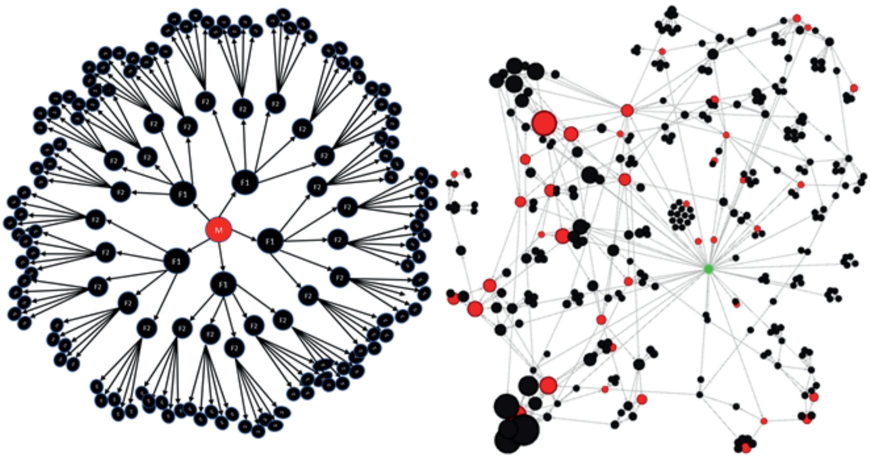

Figure 18 Perfect information symmetry (A) and empirical knowledge network (B)
Left: M=DA, F1 is model farmer and first-tier, F2 is second-tier and F3 is third tier connection to DA. Right: Green is the DA, Red nodes are model farmers, black nodes are the rest of the farmers. The biggest nodes are nodal farmers.

Characteristics of model farmers

We analysed whether model farmers shared knowledge about malt barley with significantly more people than other farmers and also compared model farmers with the rest of the farmers in terms of their socio-economic and socio-political position. The results of the statistical tests are presented in Table 8 and Figure 19.

We found that model farmers had more livestock (TLU – Tropical Livestock Units), larger farms, and more experience in malt barley cultivation. Model farmers were also more frequently in contact with DAs than other farmers. This was to be expected, since DAs appointed the model farmers as examples for the community. Most of the findings, except the education level, are typical for the characteristics of opinion leaders (Rogers 2003).

Table 8 Characterisation of model farmers (n=31) and the rest (n=77)

Variable	*Model farmers (n=31)*		*The rest (n=77)*		*Mann-Whitney test*		
Continuous variables	Mean	St.dev	Mean	St.dev		Significance	
Eigenvector centrality	0.07	0.1	0.08	0.15			0.67
Number of years the individual household head has been engaged in barley cultivation	16.58	8.19	14.71	10.47			0.06
Total land size of household in hectares	2.18	1.52	1.43	0.9			0.01
Tropical Livestock Units that the household owned in 2016 production season	7.57	3.45	4.5	2.99			0
Distance of the household to the nearby town market in km	1.09	0.62	1.15	0.83			0.91
Binary variables			*Categorical variables*	*Model famers (n=31)*		*The rest (n=77)*	
	Signif-icance	Chi-square		Mean	St.dev	Mean	St.dev
Education level	0.53	0.06	*Education level (0-3)*	1.68	0.75	1.57	0.95
Frequency of contact with DA	0	0.44	*Frequency of con-tact with DA (0-4)*	2.16	0.9	1.17	1.01
Whether the respondent participated in a training on malt barley in the past 5 years	0	0.47	*Frequency of participation in training (0-5)*	2.32	1.6	0.96	1.7
Whether the respondent participated in a demo-trial as host farmer in the past 5 years	0.02	0.22	*Frequency of participation in trial (0-5)*	1.06	1.66	0.57	1.27

Moreover, model farmers were much more likely to belong to a royal family, had family members in the political party and in the *Kebele* management, and occupied an influential position in church. This shows that model farmers were institutionally and politically better connected than the rest. Lastly, 77% of the model farmers were member of the malt barley cooperative, compared to only 36% of the rest. The primary cooperative was set-up to support farmers in accessing inputs and marketing (de Roo et al. 2019).

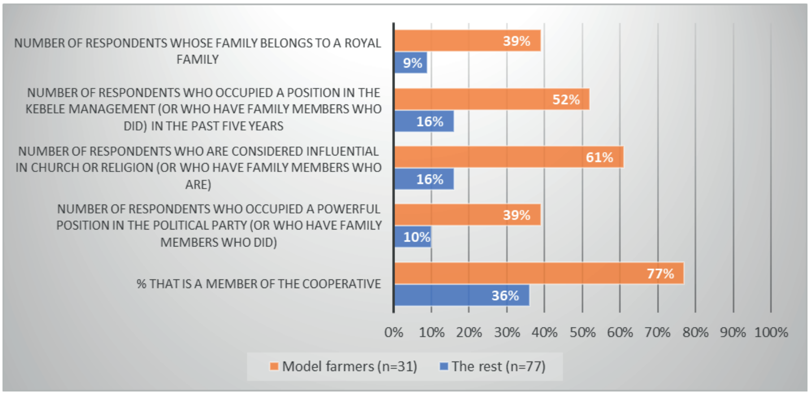

Figure 19 Socio-political characteristics of model farmers and the rest

It seems logical that those farmers who tried out the new technologies introduced by the extension service, the model farmers, were also among the first members of a cooperative that facilitates access to inputs and markets for this technology package. The findings of Figure 19 seem to confirm the role of model farmers as opinion leaders, since opinion leaders are often characterised as having high social status in their community. However, the network findings show that model farmers were not more inclined than other farmers to share their knowledge about the MBT: their average eigenvector centrality was not significantly different from the rest (see Mann-Whitney U test in (Table 8). In short, model farmers fitted most of the characteristics often ascribed to opinion leaders, but their role in diffusing knowledge was lower than expected.

Characteristics of Nodal Farmers

A similar comparison of the characteristics of nodal farmers with the rest of the farmers showed they were not wealthier, better educated, or more experienced in malt barley cultivation (Table 10), or not more often in contact with DAs and not significantly more likely to be a member of the malt barley cooperative than other farmers (Table 10). They did not have a higher socio-political status (Figure 20). They did however tend to live further away from the town centre than other farmers. Lastly, they obviously shared knowledge with others (since this was the variable determining this category of farmers).

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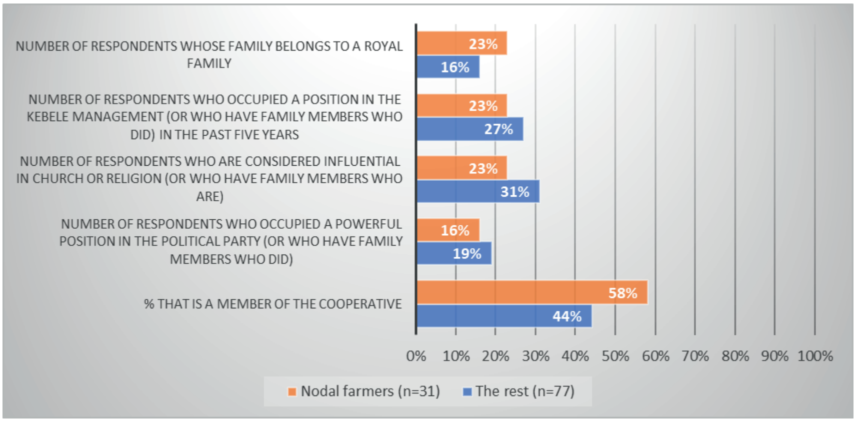

Figure 20 Socio-political characteristics of nodal farmers and the rest

Table 9 Adoption of the Malt Barley Technology by farmer category

	Average adoption index[1]	*St.dev*
Model farmers (n=31)	0.84	0.23
First-tier connection to model farmers (n=29)	0.78	0.21
*Second-tier or third-tier connection to model farmers (n=48)**	0.78	0.25
Nodal farmers (n=31)	0.79	0.19
First-tier connection to nodal farmers (n=10)	0.78	0.17
Second-tier or third-tier connection to nodal farmers (n=67)	0.7	0.32
'Ordinary' farmers (n=54)	0.68	0.31

[1] The adoption index measures the intensity of adoption of a farmer. See Annex II for a more elaborated definition.

Table 10 Characteristics of nodal farmers (n=31) and the rest (n=77)

Variable	*Nodal farmers (n=31)*		*The rest (n=77)*				*Mann-Whitney test*	
Continuous variables	Mean	St.dev	Mean	St.dev				Significance
Eigenvector centrality	0.23	0.18	0.02	0.02				0
Number of years the individual household head cultivated barley	16.52	10.6	14.74	9.58				0.53
Total land size of household (ha)	1.53	1.11	1.69	1.18				0.41
TLU owned by the household in the 2016 production season	4.7	3.1	5.65	3.51				0.35
Distance of the household to the nearby town market (km)	1.39	0.74	1.03	0.77				0.02
Binary variables				*Categorical variables*	*Nodal famers (n=31)*		*The rest (n=77)*	
	Signif-icance	Chi-square			Mean	St.dev	Mean	St.dev
Education level	0.11	0.15		*Education level (0-3)*	1.74	0.73	1.55	0.95
Frequency of contact with DA	0.32	0.1		*Frequency of con-tact with DA (0-5)*	1.26	1.03	1.53	1.08
Whether the respondent participated in a training on malt barley in the past 5 years	0.29	0.1		*Frequency of participation in training (0-5)*	1.29	1.32	1.38	1.94
Whether the respondent participated in a demo-trial as host farmer in the 5 five years	0.47	0.07		*Frequency of participation in demo-trial (0-5)*	0.07	1.38	0.74	1.42

Adoption of the Malt Barley Technology

Both model farmers and nodal farmers had a higher adoption index (0.84 and 0.79 respectively) than ordinary farmers[14] (0.68), indicating that they applied more components of the MBT (see Annex II for the definition of adoption index). The first-tier connections of model farmers and nodal farmers also had a significant higher adoption index than farmers who were not so closely connected to model or nodal farmers (Table 10). First-tier connections of nodal farmers had a similar adoption index as nodal farmers (0.78), while second-tier and third-tier connections had an adoption index of 0.70. In the case of model farmers, first-tier, second-tier and third-tier connections all had an adoption index of 0.78, indicating that they adopted 78% of the malt barley package.

When we further explored the uptake of different input components of the MBT separately, we found that model farmers significantly more often applied input related components than the rest of the farmers (average value for three dummy variables, see Annex II, data not presented), including the first-tier connections to model farmers)(Table 11). By contrast, nodal famers used a similar level of inputs as the other farmers.

We further explored the uptake of different input components of the MBT separately. We found that model farmers applied more input related components than the rest of the farmers[15]. This includes the first-tier connections to model farmers (Table 9).

[14] Respondents who were neither model farmer nor nodal farmer are referred to as 'ordinary' farmers (n=54).
[15] See Annex II, data not presented.

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Table 11 Differences in uptake of the malt barley package

	Difference in MBT adoption index		*Difference in uptake of input related components of the MBT*	
	P-value	F-value	Significance	Chi-square
Model farmers (n=31) compared to the rest (n=77)	0.01	7.82	0.01	0.26
First-tier connection to model farmers (n=29) compared to second-tier or third-tier connections to model farmers (n=48)	0	11.58	0.53	*
Nodal farmers (n=31) compared to the rest (n=77)	0.01	7.13	0.77	*
First-tier connection to nodal farmers (n=29) compared to second-tier or third-tier connections to nodal farmers (n=67)	0.03	4.8	0.41	*

** one of the cells contained less than 5 observations, so we relied on the Fisher's Exact Test.*

By contrast, nodal farmers used a similar level of inputs as the other farmers (Table 9). Table 11 furthermore shows that the nodal farmers were well connected to each other and were connected to only 10 other farmers (the first-tier connections to nodal farmers), while model farmers were connected to 29 other farmers. This suggests that nodal farmers had fewer contacts. However, nodal farmers not only had the highest eigenvector centrality, but also the highest in-degree, indicating that farmers mentioned nodal farmers most frequently as a source of knowledge on malt barley (see Materials and Methods section). So nodal farmers did link with many other farmers, but due to our sampling technique, these farmers did not end up in our analysed sample and thus not in the results.

Why are some Farmers better connected than Others?

The quantitative data shows that nodal farmers were quite similar to other farmers, except that they occupied a central position in the knowledge network. To try to explain this, we analysed the profiles of some exemplary nodal farmers, which we obtained through the participant observation and in-depth interviews (Table 12).

The qualitative data indicates that nodal farmers often have a combination of formal/political and informal/social positions in the community. In addition, they seem to have a long standing credibility among the community, mostly in trade. Business men who are well known in the community are also important sources of new information and knowledge, particularly if they travel to other places and come back with new knowledge about agricultural practices or seeds of new varieties of crops.

The qualitative data also suggests that clan-based relationships play an important role in the exchange of knowledge and other goods or inputs, which corroborates the findings of earlier qualitative research in the same community (de Roo et al. 2019). The following testimony also highlights how the social clan-based structure influences knowledge and resource distribution in the community: *"Last year the government provided 1100 kg of improved malt barley seed to incentivise the entire Kebele to grow malt barley. This ended up in a few hands, namely the few families who were among the first to benefit from the technology. The chairman of the fertiliser union distributed seeds to 11 families; I know this was in exchange for protection. Those families who receive gifts will never openly badmouth the chairman, because they realise that doing so means the end of the gifts. I don't want to be part of it. I have never been interested in politics." (interview with ID56, August, 2017).*

Table 12 Description of selected nodal farmers

ID	*Key word*	*Socio-economics*	*Description of the person*
3	Trader family	Land size 1.5ha, No oxen, non-model farmer	ID3 is part of a family of which two other brothers are also nodal farmers and traders. He trades in several commodities and travels a lot to nearby towns. The three brothers are not appointed as model farmer and they do not occupy political functions in the Kebele. They all live in the same sub-Kebele. The largest nodes in Figure 2 correspond with this family.
7	Chair of the sub-Kebele	Land size: 1.25ha, 1 ox, model farmer	ID7 is from the dominant clan and appointed as a model farmer. He is also the chairman of one of the sub-Kebeles of Guguma and has been an influential person in the Kebele for a long time. Given his position he is invited to meetings where new technologies are being discussed. He explains how good performance in the community is rewarded: Once you perform well in the system, you get other responsibilities as well. It is nice to do something for the community. (interview with ID7).
142	Farmer/ trader	Land size: 3,5 ha, 2 oxen, non-model farmer	ID142 is a wealthy farmer with many connections in the village and in surrounding towns. He used to be a trader (he still trades commodities and fertiliser on the black market). He was asked to become a member of the cooperative but refused. He prefers not to depend on the government. He thinks that the government is unreliable and does not like the hard life in Guguma: I used to live in Addis Adaba, I travelled a lot. Back then I was a merchant. I met a lot of different people. I only came back because my father asked me to as he was dying. I am the oldest son and my brothers could not come back. [he starts to cry] I am so said he died. He was strong. I have the responsibility to take over his land and farm. But I don't want to be a farmer! I don't want to have this harsh life and depend on the government for everything. I feel trapped. But I can't let my father down now, he is dead. (interview with ID 142, July 2016).

5.4 Discussion

Comparison between Model farmers and Nodal farmers

We compared two categories of farmers with the rest: model farmers who are appointed 'top-down' by the extension system and farmers with a high eigenvector centrality, who we called nodal farmers. Their key differences and similarities in terms of characteristics are summarised below.

5

Model farmers (compared with the rest of the farmers)

- More total livestock units
- Larger farm size
- More experience in farming
- Higher frequency of contact with extension agent
- Member of cooperative
- More likely to be host of demo-trials
- Not higher educated
- Often occupy influential religious/political positions
- Higher adoption index and application of external inputs

Nodal farmers (compared with the rest of the farmers)

- Often occupy a combination of formal/political and informal/social positions in the community
- Live further away from the town centre
- Slightly more likely to be member of cooperative
- Not hosting demo-trials
- Not higher educated
- Higher adoption index

Model farmers were wealthier, had larger farms and a higher social status than rest of the farmers and were more likely than other farmers to occupy an influential position in church or local authority. These findings largely match with the characteristics sketched in earlier research on opinion leaders (Feder and Savastano 2006; Rogers 2003). Our data also shows that model farmers were well-connected to the local authorities and more likely to be cooperative members, giving them better access to inputs. We can now connect the dots: model farmers are well connected to the local authorities and input distribution, which explains their higher uptake of modern inputs. However, while model farmers seem to share their knowledge more or less according to the 1-5 approach, they did not have a higher eigenvector centrality than the rest, implying that they played a limited role in knowledge dissemination. This raises the question of the effectiveness of the model farmer approach, or more broadly: whether model farmers are opinion leaders at all, as the Ethiopian extension model assumes.

The other category of farmers that we studied, nodal farmers, were not appointed by the government extension system but emerged from within the community. Farmers referred to nodal farmers more often than to other farmers as source of knowledge on malt barley. The analysis showed that nodal farmers are not very different from their fellow farmers in terms of wealth, education and social status. Yet, our qualitative data indicated that these nodal farmers often occupied a combination of formal and informal positions in the community. Nodal farmers tended to be less active in political spheres than model farmers. By contrast they were active in trade, which did not come out as an obvious characteristic in the quantitative data but is clear from the qualitative data. The high eigenvector centrality (0.23 versus 0.07) indicates that they were more effective than the model farmers in disseminating knowledge about malt barley to the entire community. Because their eigenvector centrality was high, we know they are either gatekeepers or closely connected to gatekeepers, who are the link between different sub-communities in the village.

One of the explanations for the centrality of nodal farmers may be their socio-economic similarity to their peers, which may make them more easily accessible to others. Because model farmers were significantly wealthier and tended to have important social functions in the community, there may be socio-political barriers that affect their capacity to act as an example for others. Other farmers may think that their lower level of resource endowment makes them different to model farmers and that the technologies that model farmers adopt are not suitable for them. In a study on the diffusion of integrated pest management in farming communities in Indonesia, Feder and Savastano (2006) similarly found that when the social status of opinion leaders was markedly different from others in the community, this reduced their effectiveness in disseminating knowledge.

The higher adoption index for first-tier and second-tier farmers under the model farmer model, confirms that social learning was a powerful force for adopting new technologies, which has also been found by others (such as Krishnan and Patnam 2014). However, the study also shows that knowing about a technology is not the only factor of importance, access to inputs is also critical. In Guguma, cooperative membership is a good proxy for access since membership enables privileged access to scarce inputs such as seed and fertiliser (on a credit basis).

Complementary Insights from Quantitative and Qualitative data

This study showed, in both quantitative and qualitative terms, that it is the *type* of contacts that influenced the uptake of the technology. An important complementary insight that emerged from the qualitative data was that clan-based relationships, sometimes dating back generations, play an important role in the exchange of knowledge and goods. The relevance of ethnicity and clan-based relations was also found in a study on agricultural extension in Oromia communities in Ethiopia (Matouš et al. 2013). It was not possible to quantify the influence of clan-based relations on knowledge dissemination.

The complexity of social relations in the community shows the difficulty that development projects face in identifying 'the right' people who can help to introduce and scale-up agricultural technologies in a community. Using a combination of qualitative and quantitative approaches to understand opinion leadership and technology diffusion does help to triangulate the findings. Qualitative data may show the most effective entry-points for knowledge exchange; whereas relying solely on network data and statistics does not do justice to 'hidden' variables such as clan-based relationships and/or political influence. Our study suggests that knowledge and technologies do not travel in neutral or free-from-bias ways to the wider community, but tend to remain within certain cliques. This is in line with earlier work done by social network theorists, indicating the existence of structural holes (Burt 2000; Granovetter 1973) and the limitations they place on the diffusion of knowledge.

5.5 Conclusions

Our findings suggest that the effectiveness of the model farmer approach in the Ethiopian extension approach is limited by two main factors: firstly, model farmers are not very effective in disseminating knowledge and secondly, they may be too different from the rest of the community – socially, politically and economically - to be regarded as effective examples. These findings have two important implications for organisations promoting the diffusion of improved technologies in LMICs.

First of all, this study confirms that in areas where information about technologies is not easy to come by, the diffusion of knowledge is an important pre-condition for the widespread adoption of improved technologies. However, since knowledge does not travel in a free-from-bias way, relying on government structures for knowledge diffusion runs the risk that development projects may perpetuate the status quo of inequality and poverty (Cleaver 2005). The empirical evidence on this topic is ambiguous. Some scholars have pointed to the risk of elite capture (Platteau 2004), referring to rural elites who have the capacity to capture resources allocated for rural development projects. However, in a seed network analysis, Tadesse and her colleagues (2016) found that model farmers were the most effective sharers of seed of new potato varieties in their community and thus the most effective collaborators for development projects to achieve their goals. In an experimental study (using randomised control trials) on the local management of development projects in

Sierra Leone, Voors et al. (2018) found that local elites were powerful players who could block or hamper development projects. In concluding we argue that, a social network analysis (combined with qualitative socio-political analysis) may be an effective alternative to relying on government structures and for identifying bottom-up opinion leaders. Making use of those members of the community with bridging capital (Burt 2000), i.e. those who are able to connect different horizontal and vertical social groups, increases the likelihood that knowledge about agricultural technologies reaches more people and more sub-communities.

Secondly, this study shows that knowledge is not enough. Demonstrating new technologies should always be accompanied by efforts to remove barriers to access to seed and inorganic fertiliser (and output markets). Our case shows that when inputs are scarce, pre-existing social relations in the community may perpetuate inclusion and exclusion, with model farmers, who are well connected to the local political system, having better access to inputs than other categories of farmers.

Chapter 6

Discussion

6.1 Revisiting the research question

In this thesis I embraced the lens of Political Agronomy, a relatively young domain inspired by STS and Political Ecology, to explore the social and political dimensions of technology promotion as part of an Ethiopian-Dutch agricultural research for development programme called CASCAPE. The main research questions were: How do socio-political factors shape the interactions between key actors involved in the process of agricultural technology promotion in Ethiopia and how does this result in inclusion/exclusion? In three case study chapters and a context chapter I zoomed in on interactions between different actors involved in the process of promoting agricultural technologies, and different dimensions of this process: on-farm trials, the dynamics of accessing and opinion leadership.

In the following section (6.2) I summarise the main findings of each empirical chapter and synthesise the findings to answer the main research questions. In Section 6.3 I discuss the underlying mechanisms which contribute to the self-reinforcing nature of social exclusion during the promotion of agricultural technologies, followed by section 6.4 where I present a number of implications that follow from seriously considering the socio-political dimensions of technology promotion. In section 6.5 I elaborate on possible areas for further research, followed by the final conclusion in section 6.6.

6.2 Summary of main findings

Table 13 Summary of findings

Nr	*Interactions between actors*	*Socio-political factors*	*Inclusion/exclusion*
2	• Despite decentralisation policies Ethiopia's research and extension system is still rather top-down with limited flexibility to respond to diverse needs of farmers • Agricultural extension delivery is entangled with politics, expressed through '*encadrement*': model farmers and development groups as extension of the state to control farmers' planting decisions • Loyalty to the ruling party is a moral law. Public space for open critique is nihil making it unlikely that farmers will publicly raise concerns.	• Farmers and local authorities have cultivated a relationship of mutual dependence, originating from historical reciprocal relations of loyalty, accountability and upward mobility. Both farmers and local authorities reinforce the status quo through their behaviour • It may not be a matter of flawed approaches (e.g. model farmers) but the entanglement with politics which negatively influences the effectiveness of extension services.	• Farmers who perform well in the existing system are rewarded with economic and political opportunities • Farmers who are not able or willing to follow the government's directions are framed as 'the enemy' and socially and economically excluded • The push into the neo-liberal system increases smallholders' dependence on the government and market and their vulnerability • Relatively poor farmers and/or farmers with a low social status face challenges to access oxen and labour through reciprocal arrangements.
3	• Local authorities play a decisive role in site and farmer selection • On farm trials take place at the interface of actors with diverse interests, power positions and backgrounds • Researchers need scientific credibility; local authorities need successful trials and farmers to enrol in their programme • Farmers have different interests, which is reflected in their participation behaviour. Without	• Farmer selection for on-farm trials is biased towards better off farmers and better farms • On-farm trials are predominantly evaluated based on yield data. Other criteria important for scaling are often unreported • Biases in trial organisation and evaluation are caused by a perceived pressure to	• The identified biases limits their external validity (both agroecologically and socio-economically) which is important for scaling • Marginalised farmers are particularly affected because they are not part of the testing phase of new technologies. This bears the risk that the technologies are not appropriate nor affordable for this group of farmers.

6

	independent evidence on farmers' interest in sustained use of improved technologies, metrics such as 'participation in on-farm trials' are not appropriate as proxy for adoption.	demonstrate success (and not failure) among researchers and local authorities.	
4	• Farmers and local authorities are engaged in a web of interactions that are beyond the technology • Often invisible exchange mechanisms such as clan-based loyalty, reciprocity and vertical accountability are of critical importance in governing access to the material and social components of improved agricultural technologies • Unlike wealthy farmers, marginalised farmers do not have the time and resources to 'be around' and show their face during meetings and gatherings.	• AR4D projects often perceive technology as a technical fix regardless of the context. In the case of malt barley the material cannot be separated from the social components of the technology • Access to social components of a technology (agronomic knowledge, markets, and cooperative membership) is always negotiated; 'Being around' is a pre-condition for access to these components.	• Mechanisms of access and social inclusion/exclusion reinforce each other. Farmers who 'are not around' are portrayed as 'lazy' and 'not serious', excluding them for being selected for projects or extension services • By ignoring the 'social rules of the game' the malt barley intervention has likely resulted in a negative scaling effect: a perpetuation of the social and economic gap between a few better off farmers and a larger group of poor farmers.
5	• Model farmers are not the most effective way to diffuse knowledge in a community; nodal farmers, who emerge from the data, are more effective in knowledge sharing • The type of connections that farmers engage in is an important factor for adoption of malt barley. Nodal and model farmers and those connected to them have a significantly higher adoption index than the rest of the farmers.	• Knowledge about new technologies does not travel in free-from bias ways • When access to external inputs is constraint, knowledge is important but not enough for the widespread adoption of agricultural technologies • Nodal farmers are 'gatekeepers', mediating access to knowledge.	• Relying on government structures for the dissemination of agricultural technologies results in the exclusion of nodal farmers who have a central position in the community • Model farmers are part of the political elite, granting them privileges like cooperative membership, interest-free credit, and a premium price for selling. Other farmers are often excluded from these benefits.

Socio-political factors shaping interactions

As summarised in Table 13, during the process of agricultural technology promotion both researchers and local authorities perceive a pressure to demonstrate positive results. For researchers involved in AR4D initiatives in other countries (e.g. Bangladesh and Southern Africa, see also chapter 3) this pressure is mainly an increased donor pressure to demonstrate impact at scale, preferably as quickly as possible. Chapter 2 and 4 show that in Ethiopia, it may not be so much donor pressure, but rather the perceived pressure to meet imposed targets from regional and national governments, such as the number of farmers using seed of improved varieties and chemical fertiliser, and on how much acreage. Local authorities and researchers thus both need potentially successful farmers to enrol in their programmes in order to show positive results in trials and demonstrations.

Farmers on the other hand have different interests, which is reflected in their participation behaviour in activities related to technology promotion. Chapter 2, 4 and 5 showed that farmers' participation in extension activities may stem from other reasons than simply being interested in the technology, namely from the need to engage in strategic network building and to demonstrate loyalty in expectation of future benefits or a confirmation of their social status. These findings are in line with what Kiptot and her colleagues framed as 'pseudo-adopters', based on findings on an AR4D project in Kenya where they found that farmers motivation to participate in on-farm trials were influenced by the expectation of other benefits (social, political, economic) rather than their genuine interest in the technology (Kiptot et al. 2007).

The malt barley technology package was introduced in highland communities in Ethiopia with the structural constraint of limited availability of external inputs (seed and fertiliser in particular). In this context of scarcity, access to the 'social components' of the malt barley technology are relational and negotiated among local authorities and among farmers themselves. The social components of the malt barley technology cannot easily be separated from the material ones, as they are both needed for the widespread adoption of the malt barley technology package. The social networks of farmers and local authorities mediate access to the seed, the fertiliser and the oxen. The malt barley technology could be considered as a network of material and immaterial components whereby the social networks of farmers and local authorities mediate access to seed, fertiliser and oxen. This is similar to how the STS scholar Callon described the sociotechnical network in his study of scallops and fishermen in France (Callon 1986). Considering technology as a sociotechnical network helps to understand both the components as well as the connections which should be forged or altered to 'make the technology work'.

Effects on social inclusion and exclusion

Inclusion

The first overarching finding is that the current Ethiopian research and extension system has been (re)producing an exclusive category of successful farmers who are prioritised in terms of support and praised for their performance. Often called model farmers, these farmers are part of a local elite who are selected to try out new technologies first, host on-farm trials, and receive external visitors such as AR4D project visits, local and regional media and regional authorities. In return for their loyalty to the authorities (including extension agents), model farmers have privileged access to cooperative membership, which grants access to external inputs on free from interest credit basis and market access with premium prices. Additionally, model farmers are often rewarded with social, economic and political opportunities for upward social mobility (see chapter 2 and 4 for detailed examples). While the category of model farmers or elite farmers has been existing since the Derg regime, the respective farmers that constitute this category have changed over time, as shown in chapter 2.

CASCAPE naively relied on government structures and its model farmers for the promotion of new technologies. Chapter 5 showed that the model farmer approach is less effective for the dissemination of knowledge, because knowledge about improved agricultural technologies does not travel in free-from-bias ways, but is mediated by social relations. While model farmers have close linkages to local authorities and thus better access to external inputs, their role in the dissemination of the knowledge about malt barley is limited as compared to other farmers (nodal farmers in my case). Nodal farmers emerged from the network analysis as influential nodes, playing a gatekeeper role in knowledge dissemination. Nodal farmers are socio-economically not different from their peers, which could make them more appropriate as entry-points for knowledge dissemination since other farmers can recognise themselves in these farmers, in contrast to model farmers who are wealthier and have a higher social status than the rest of the farmers in the community.

Exclusion

Besides the exclusive category of model farmers, the four empirical chapters also brought mechanisms of exclusion to the foreground. This thesis showed that the majority of smallholders receives limited attention from researchers (see chapter 3) and extension agents (see chapter 2 and 4), and if so primarily by DAs who have a central message for all: "use chemical fertilisers!" These findings are in line with the commonly accepted view that the current research and extension system in Ethiopia is only to a very limited extent able to tailor its services to the needs of smallholder farmers, in particular to those with limited land, labour and financial means to take a loan or invest in external inputs (Davis et al. 2010; Leta et al. 2018).

As the CASCAPE programme was meant to provide evidence on agricultural research for development approaches (and not to eradicate poverty as such), it largely relied on government structures for the selection of participants for scaling activities. As a result, non-model farmers were often excluded in activities and as beneficiaries of the programme. The biases which are introduced in the organisation of on-farm trials bear the risk to compromise the scaling potential of the technologies that are being evaluated. Not only because the on-farm trials are organised on less representative farms with less representative farmers, but also because indicators important for scaling are not being evaluated. However, the empirical findings of this thesis suggest that the effects of these biases and the subsequent exclusion stretch further than simply being deprived of extension services. The literature review in chapter 2 showed that the current extension discourse portrays farmers who are not willing to be enrolled in the system as disloyal dissenters, referring to the popular language used during the liberation war in the 1990s. The empirical data from chapter 4 confirmed this claim by showing that unwilling or uncapable farmers were systematically portrayed as 'lazy' or 'not serious'. The effects of this discourse and practice are both social and economic. Economically, using social pressure to push subsistence farmers into the neo-liberal market system increases their dependence on the government (for credit and inputs) and the market (see chapter 4), which - according to critical voices - further increases their vulnerability (Cafer and Rikoon 2017; Planel 2017). I am not arguing that the direction towards commercial farming is right or wrong. However, AR4D programmes that do not complement the introduction of agricultural technologies with other types of support such as access to inputs, markets and finance may (unintentionally) push already vulnerable farmers further into the vicious circle of poverty.

Socially, one can imagine how prescribing farmers' planting decisions impacts farmers' deprivation of the experience of individual freedom. This raises the question on whether it is desirable if AR4D initiatives, often financed with tax-payers money, contribute to this (albeit unintentionally). Furthermore, chapter 4 showed that farmers who do not have the time or resources to 'be around' and invest in relations with local authorities are further marginalised in the sense that their (already low) social status is further downplayed due to a perceived lack of commitment to the government's programmes. In line with this, the limited space for non-participation and other forms of public dissent puts marginalised farmers in a difficult position. The only option for expressing their dissatisfaction may be in devious ways, also called strategies of ‘everyday resistance’ (Scott 1985), which were reported in chapter 4 where farmers expressed their discontent only in very subtle ways and never in the presence of DAs, authorities or model farmers.

Concluding, the attitude of the CASCAPE programme in terms of participant selection and perceiving technology as a technical fix has possibly resulted in a ‘negative scaling’ effect: a contribution to the maintaining of the social and economic gap between a few better off farmers and a larger group of poor farmers. It is important to see this conclusion in the context of how the CASCAPE programme has been positioned, namely as strategic investment by the Royal Netherlands Embassy and the Ethiopian government with the aim to develop and test promising approaches that increase agricultural productivity. In this framing, poverty alleviation is not at the core of CASCAPE and considered as externality, i.e. outside the influence of the programme. This thesis shows that this framing bears the risk of contributing to a perpetuation of the status quo and the processes of social exclusion that already existed.

6.3 The reproduction of social exclusion

A Political Ecology line of thinking brings to the foreground a red thread throughout the empirical chapters, namely that social exclusion is self-reinforcing. Placing the process of technology promotion in the wider context of historical relations between the authoritarian state and its citizens, sheds a different light on certain underlying mechanisms that contribute to a continuation of the current system whereby certain groups are included and others excluded during the agricultural technology promotion process.

Firstly, Ethiopia's long history of authoritarian central rulers has been characterised by a feudal relationship between authorities and citizens, incentivising political competences among citizens to develop ties with local rulers rather than working hard on the field (chapter 2). Related to this are the continuous shifts in power and consequent reversions of 'winners and losers' in terms of support, benefits, exclusion to or loss of valuable assets. Consequently, the lived experiences of farmers culminated in a broad base of inherently opportunistic citizens who, on the one hand, avoid dependence on their unreliable rulers, but on the other hand never openly dispute these same rulers as long as they are in power. This was also visible in the events described in chapter 4 and 5. Certain farmers felt pushed to use fertilisers and seed when they preferred to do things their own way. Some tried to avoid dependence on the government, at the cost of having a low social status, while others went along but showed resistance in very subtle ways. Similarly, Cafer and Rikoon (2017) found that some vulnerable farmers shifted to cash crops (notably *khat*[16]) to avoid dependence on the government and fertilisers. It may even be a plausible explanation for the existence of another clique (nodal farmers, see chapter 5) next to model farmers. Nodal farmers are well connected to each other and other community members, but not well connected to the political system.

[16] *Khat* is a stimulant considered a (legal) soft drug in Ethiopia. It's widely consumed in Ethiopia and beyond and a lucrative business (Cochrane and O'Regan, 2016).

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Another mechanism which reinforces the status quo, is the observation that certain social conventions which have been established over time, i.e. the ‘right ways’ of socialising and participating in public life and technology promotion, tend to reproduce social structures of inequality. In chapter 4 I found that due to limitations in social networks, time and financial means, poor farmers are not able to fulfil these social expectations and thus disrespected by the community and authorities. These findings confirm the conclusions of Cleaver (2005) that social conventions indeed tend to reinforce existing relations of authority and exploitation, which channel everyday actions to reproduce such social structures. In line with this, while reciprocal arrangements are mentioned publicly as a commonly accepted mechanism for accessing oxen and labour, barely disguised social factors influence access to manpower and oxen. This is in line with a study on seed exchange mechanisms in Ethiopia conducted by McGuire (2008), which brought to the fore that local community support mechanisms are not as generous or unconditional as they might appear to outsiders.

In short, farmers, researchers and local authorities are entangled in mutually reinforcing reciprocal relationships. As long as the underlying incentives and sanctions do not change, the key actors involved in the process of agricultural technology promotion in Ethiopia are not likely to proactively break this entanglement. In this way, external AR4D initiatives that are blind for these underlying mechanisms and naively follow government structures thus contribute to the perpetuation of the status quo and to processes of exclusion and marginalisation of already marginalised groups in society.

A synthesis of the findings is presented in Figure 21 below.

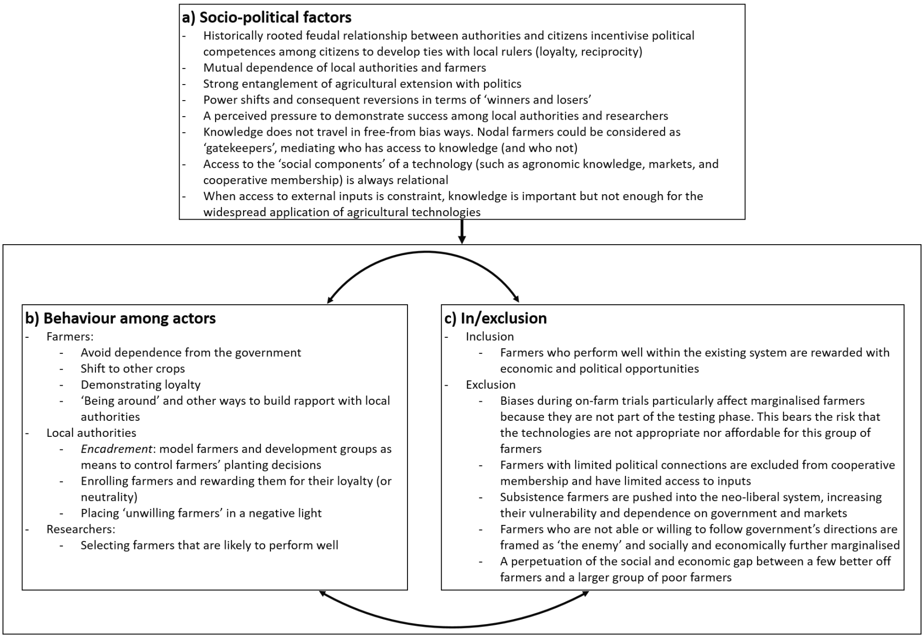

Figure 21 The reproduction of social exclusion

In box A in Figure 21, the socio-political factors that underpin most of the interactions between farmers, researchers and local authorities are summarised. Actors have developed certain behaviour to deal with these factors, presented in box B. One of the effects of these strategies is the (re)production of a small group of elite (model) farmers who receive agricultural support, as well as related economic and political opportunities (box C). The other side of the coin is the exclusion of the majority of farmers (in particular subsistence farmers) from this support. Other forms of exclusion are summarised in the box in the right corner. Lastly, I found that social exclusion and coping strategies are somehow self-reinforcing, resulting in a perpetuation of the socio-economic gap between a few better off and a larger group of marginalised farmers.

6.4 Implications of the findings

In this thesis I basically argue that it is ineffective to ignore the socio-political context of technology promotion. What would it entail for policy makers, impact investors and practitioners involved in AR4D initiatives to take these dimension serious?

Being explicit about the type of change that is required for effective AR4D

Impact investors and AR4D practitioners do not always sufficiently think through what it actually implies to claim to contribution to the Sustainable Development Goals or sustainable food systems. If we keep on doing what we always did, we will keep on receiving what we always had (Quote Investigator 2016): reinforcing the status quo including the negative effects in terms of social exclusion demonstrated in this thesis. AR4D that effectively contributes to food systems transformations and the SDGs should reflect on its position in relation to the underlying structures which caused inequalities and poverty in the first place (Rossi et al. 2019).

Analysing and addressing power relations

The default vocabulary of many AR4D initiatives (CASCAPE included) is to de-politicise sociotechnical change, which deviates the attention away from underlying structures that reproduce inequalities. However, the findings of this thesis suggest that power is an important contextual factor to deal with. A proper power analysis would help to identify actors, their interests and their relative power position, as well as underlying socio-technical structures that inhibit change, and (latent) opportunities to transform exclusionist practices. In this regard the insights of Partzsch (2017) may be helpful, indicating that power is not a zero-sum game.

Employing participation as means for empowerment

Since many AR4D initiatives are closely linked to governments, they are often seen as extension of the government and as such not perceived by local communities to act independently from authorities. Chapter 2 and 4 clearly demonstrate that it is unlikely that farmers in Ethiopia will publicly raise concerns or critique development programmes. In this particular political context, participatory approaches may be ineffective as tool to understand farmers' perspectives, needs or feedback on introduced technologies.

Taking this conclusion a step further, Hickey and Mohan (2005) found that participatory methods are most effective in achieving transformative change when they: (1) are part of a broader initiative that seeks to directly challenge existing power relations rather than simply work around them for more technically efficient service delivery; and (2) are directed towards a close engagement with underlying processes of development and inequalities (Hickey and Mohan 2005). In the Ethiopian context these conditions would imply that impact investors and AR4D initiatives are required to reflect on their own role and position in relation to (local) partners as well, acknowledging that they are part of a larger arena of power structures and their responsibility in addressing these.

Furthermore, chapter 4 showed that that due to socio-economic constraints, the most marginalised groups in the community are often not able to participate in development projects or other forms of collective activities in the first place, implying that extra and appropriate efforts are needed to reach these groups (Cleaver 2005; Francis 2001). Taking this line of thought one step further, one could argue that additional interventions for marginalised groups may be needed to create an equal playing field before actually engaging in agricultural research or technology promotion.

Embracing the vocabulary of sociotechnical networks

As became clear in chapter 4 and 5, an overt focus on the material components of improved technologies (i.e. seed, fertiliser) implies that the political and social context including access to external inputs are easily overlooked in the initial stages of technology promotion. Alternative conceptualisations to technology are not new but they somehow did not trickle down to the majority of actors involved in AR4D. Considering technology as sociotechnical network (Callon 1986) alters the type of technologies that could be promoted in LMIC. When contextual constraints such as access to land, oxen, labour, financial capital and pre-existing social networks are into account, a logical next step would be to shift away from the promotion of single varieties and fertiliser only, towards a wider basket of options (Ronner 2018; Tittonell et al. 2005), including off-farm options and technologies for which access to land or other forms of capital are less of a pre-condition.

Understanding adoption and measuring progress

Pushed by the donor agenda to contribute to the SDGs, the nature of evidence production in AR4D often includes indicators such as adoption rates and number of farmers participating in trials as proxies for improvements in nutrition security and income increase. Without independent evidence substantiating farmers' genuine interest in sustained use of improved agricultural technologies, such metrics provide the misleading indication that a given technology 'works', while the produced metrics are merely an artefact of the AR4D process itself. Furthermore, a focus on adoption disregards farmer technology adaptation, dis-adoption, and the external drivers of technological change (Glover et al. 2016; Kiptot et al. 2007).

Understanding the drivers of technology adoption requires AR4D initiatives to explore the motivations, farming systems and incentives of individual farmers and farming communities. At farmer level, this may include the deployment of socio-economic questionnaires, interviews or choice experiments to understand access, demand(s) and perceptions of different categories of farmers (Almekinders et al. 2019; Barrowclough and Alwang 2018; Wang et al. 2019; Bulte et al. 2014; Duflo et al. 2011). At community level, this may include approaches to understand community dynamics, power relations, and possible entry-points for the diffusion of knowledge, seed or other components of agricultural technologies. Interesting experiences in this regard are the work of Abay et al. (2011) and Tadesse et al. (2017) for seed networks; Arora (2012a) and Hoang et al. (2006) for knowledge networks; Hermans et al. (2017) and Spielman et al. (2010) for rural innovation networks. In relation to power, the work of Partzsch (2017) is relevant, however her work has not been applied yet to agriculture and LMIC. At regional or national level a better understanding of the role of historical and political factors in sociotechnical change trajectories may be important, which could be done through (a combination of) political economy analysis, trend analysis and/or literature reviews.

While I am critical about the overt focus on on-farm trials during technology promotion, the use of on-farm demonstrations is still an effective method to popularise new varieties and agronomic practices. Selecting farmers for such demonstrations who are similar to their peers may be more effective than selecting farmers who are socially and economically too different from fellow farmers, as shown in chapter 5. This is also confirmed by Feder and Savastano (2006). Making use of those members of the community with bridging capital, who are able to connect different horizontal and vertical social groups, increases the likelihood that knowledge about agricultural technologies reaches many people or many sub-communities (Burt 2000). Network analysis has the potential to be an appropriate alternative for relying on government structures to identify the right entry-points for the dissemination of knowledge, seed, but also for an inclusive embedding of technologies in a community.

Rethinking Political Agronomy: The politics of food systems

Finally, together with other empirical contributions, this thesis made me reflect on the appropriateness of the name Political Agronomy. Most contributions of Political Agronomy have so far focused mainly on contestations in the production of agronomic knowledge and/or the agronomic research community, and to a lesser extent on the political and social dimensions of technology *promotion*. A quick review of Political Agronomy titles in Google Scholar yielded two books and ten other publications with Political Agronomy in the title or abstract, of which 1/3 was mainly on development/extension/ promotion and 2/3 on agronomic knowledge production[17]. Nevertheless, the title Political Agronomy suggests that it's the domain of agronomy that is under scrutiny, while to me it is rather the domain of agriculture and food in general, including extension, scaling and the promotion of agricultural technologies. If you take this into consideration, besides agronomy, the domain would include disciplines such as economy, sociology, nutrition, law, political science, extension, as well as non-scientific actors. Given all this, may it be more appropriate to speak about the political economy of food (Harris et al. 2019) or the politics of food systems rather than of agronomy only.

6.5 Emerging issues for further research

This PhD thesis has only covered a minor part of the field of Political Agronomy; it's geographical scope is limited to Ethiopia only, and it's empirical domain is balanced towards agricultural technology promotion (rather than agronomic research). Based on the findings of this thesis, a number of questions emerge that deserve further scientific attention in my view.

[17] It has to be noted that the second book on Political Agronomy, 'Development-oriented agronomy' (2017) is quite balanced in terms of its focus.

Balancing in-depth case studies with cross-case analysis

First, it seems that contributions in the field of Political Agronomy so far have mainly been in-depth case studies at a single geographic scale (mostly micro or meso level). My thesis shows that it is relevant to zoom in and out between different geographical scales because this brings to the foreground how underlying structures at one scale trickle down to or can be explained by other geographical scale(s). For instance, the notion of 'being around' and the portraying of farmers as 'lazy' and 'not serious' in chapter 4 could be linked to a wider pattern whereby the national state (and international donors) pushes the modernisation project onto farmers and portrays those who are not able or willing to join this movement as disloyal dissenters. The notion of 'chain of explanations', used in Political Ecology (Robbins 2012), may be useful in this regard. Chain of explanations refers the process of explaining local, micro-level phenomena, by following the underlying structures and patterns that cause these phenomena to take place. It may be interesting to further explore this line of thinking in other studies on agricultural technology promotion, to identify how the symptoms of inequality and exclusion may be linked to or explained by deeper structures of exploitation, power relations, and disempowerment that take place at higher empirical levels. Such an endeavour has scientific relevance because it would contribute to the formulation of generalised principles on how socio-political factors affect inclusion and exclusion in specific contexts. This could however also have practical relevance eventually, once the insights stemming from this analysis would be translated to policy recommendations and shared in different communities of practice.

Linked to the above, is the need to balance the often anecdotal and qualitative case studies with more generalised hypothesis on the role of the socio-political context in agricultural technology promotion. It is one thing to have a collection of relevant in-depth case studies analysing political dimensions of agronomic knowledge production in specific cases, but what is needed as well is comparing and synthesising insights *across different contexts*, for example what we started to do in chapter 3 where we compared insights on the organisation of on-farm trials in AR4D initiatives across three different geographic and socio-political settings. This would pave the way to develop and test generalised hypotheses outlining how certain socio-political factors have localised effects on inclusion/exclusion in contexts with certain properties. For instance, influential contextual features of my thesis were the historical state-citizen relations characterised by mutual dependence and exploitation, the absence of colonialism, ethnicity, and scarcity of modern inputs. But how would inclusion and exclusion play out in different contexts: which factors would have similar or totally different effects? And are there other socio-political factors that did not feature strongly in my case but are important for other contexts? This thesis has placed little emphasis on access to markets or market dynamics for instance, which could be another relevant domain for the exploration of socio-political dimensions.

Methodological reflections

Methodologically, the combination of quantitative and qualitative approaches in this thesis proved to be fruitful. While qualitative methods were crucial to identify often invisible mechanisms such as clan-based relationships, loyalty and/or upward mobility, quantitative approaches such as network analysis and regression analysis and statistics were pertinent for linking these mechanisms to wider conclusions on cooperative membership, adoption intensity, knowledge dissemination. It would have been interesting is to expand the analysis and link the identified mechanisms to other relevant quantitative measurements such as incomes, poverty and adoption. Or the other way around: linking other quantified networks (such as labour, seed, or clan-based networks) to qualitative mechanisms of access and exclusion. Besides being complementary, using multiple data collection techniques also serves as a means to triangulate findings, such as in this thesis the importance of membership of the malt barley cooperative for accessing inputs. It is highly relevant to repeat the combination of qualitative methods for the identification and categorisation of socio-political factors, with quantitative methods to understand the wider effects on income, adoption, poverty and other effects of these socio-political factors, in other contexts and compare findings to come to general patterns and hypotheses.

Another avenue for further methodological development is to connect methodological and conceptual advances in analysis of power dynamics better to the AR4D research community. Methods such as the power cube (Gaventa 2006), power analysis (DfID 2009), or conceptual frameworks like the POINT framework (Avelino 2017) or the framework developed by Rossi (2019) are very relevant, but these methods and frameworks are developed and used in other domains and contexts (sociology and environmental science notably) and thus need to be translated to the domain of the Politics of Food

Systems. This translation will not only be about content, but also about the use of appropriate vocabulary and the art of conducting inter- or cross-disciplinary research. A warning note should be made here: based on earlier efforts to include socio-political dimensions in AR4D, one of the risks is that power could be 'mainstreamed away' (Mukhopadhyay 2004), like what often happens to the mainstreaming of gender into agricultural research whereby gender equality as outcome with a dedicated budget and resources is reduced to the counting of male and female farmers as beneficiaries.

6.5 Final conclusion

The main conclusion of this thesis is as follows. Farmers, researchers and local authorities in Ethiopia are entangled in mutually reinforcing reciprocal relationships. As long as the underlying incentives and sanctions remain unchanged, the key actors involved in the process of agricultural technology promotion are not likely to proactively break this entanglement. External AR4D initiatives (such as CASCAPE) that are blind for these underlying mechanisms and naively follow government structures are likely to contribute to the perpetuation of the status quo and to processes of exclusion and marginalisation of already marginalised groups in society. To overcome this, impact investors and practitioners need to be better aware of the power relations and social dynamics that underpin the interactions between farmers, local authorities, and researchers during agricultural technology promotion, for instance during the organisation of on-farm trials or other technology promotion activities organised by regular extension or AR4D projects. Next to awareness, it is important that impact investors and AR4D initiatives critically reflect on their own role in relation to (local) partners, acknowledging that they are part of a larger arena of power structures and have a responsibility in addressing these. In the particular political context in Ethiopia, participatory approaches are less ineffective as tool to understand farmers' perspectives, needs or feedback on introduced technologies. To be able to truly benefit from AR4D initiatives, an equal level playing field should be created first, before marginalised groups are able to participate in or benefit from agricultural technology promotion.

I see three main contributions of this thesis. Firstly, this thesis demonstrated how ignoring the socio-political context in AR4D results in the reproduction of social exclusion of marginalised groups. Secondly, I opened up the black box of agricultural technology to include dynamics of access and the social relations that mediate this access. The latter was found to be useful as it opens up the opportunity to move away from the overt focus on on-farm trials, towards a more diverse pallet of approaches such as network analysis and analysis of access dynamics in agricultural technology promotion. Thirdly, the research in this thesis showed the importance of networks (as opposed to individuals) in relation to technology promotion: knowledge networks, political networks, clan-based networks, labour and oxen-exchange networks. These networks are often heterogeneous, since they consist of material and social components and mediate access to components of agricultural technologies.

Due to its in-depth character and focus on Ethiopia, this thesis is limited in scope. Several features make Ethiopia a unique country.

This specificity reiterates once again how important the context is for AR4D. Rather than extrapolating the results to other countries, I would encourage researchers involved in AR4D projects elsewhere to consider the socio-political context as the starting point of their endeavour, rather than an aspect that only comes to mind when the project (or respective technologies) need to be 'brought to scale'.

When I started this study, I expected to be able to formulate specific recommendations on how to deal with farmer selection, access to (components of) agricultural technologies, and the role of model farmers in agricultural technology promotion. Along the way, rather than providing clear-cut answers, this thesis raised new questions. Based on the findings of this thesis, some questions that need further exploration are:

- How to practically integrate issues like power and politics into agricultural research for development programmes without making such programmes overly complicated?
- What is the role and mandate of external AR4D initiatives to address power dynamics?
- What are appropriate and acceptable indicators to track and understand progress in agricultural technology promotion, which do justice to the interrelatedness between technology and power?

The main aim of this dissertation was to shed a light on an underreported aspect of agricultural technology promotion, namely the socio-political context during agricultural technology promotion. I trust that this thesis will be a building block for further research and development in relation to dealing with the socio-political context in technology promotion and achieving social justice in a changing world. I hope to have inspired others take this challenge forward.

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Annex I Selected publications literature review

	Author	Title	Year
		Reviewed policies	
1	MoFED	Plan for Accelerated Growth and Sustainable Economic Development (PASDEP)	2006
2	MoANR	Agricultural Growth Programme I (AGPI)	2010
3	MoANR	Agricultural Growth Programme II (AGPII)	2015
4	MoANR and ATA	Draft Extension Policy	2015
		Reviewed resources on Ethiopia's agricultural history	
1	McCann, J.C.	People of the plough, A history of Ethiopian agriculture 1800-1991	1995
2	Clapham, C.	Ethiopian development: The politics of emulation	2006
3	Kassa, B. and Alemu, D.	Agricultural research and extension linkages: Challenges and intervention options	2016
		Reviewed Ethiopia's agricultural extension literature	
1	Abebaw D., Haile M.G.	The impact of cooperatives on agricultural technology adoption: Empirical evidence from Ethiopia	2013
2	Bachewe F.N., Berhane G., Minten B., Taffesse A.S.	Agricultural Transformation in Africa? Assessing the Evidence in Ethiopia	2018
3	Berhane, G. Ragasa, C. Tadesse, G. and T.W. Assefa	The state of agricultural extension services in Ethiopia and their contribution to agricultural productivity	2018
4	Davis K., Swanson B., Amudavi D., Mekonnen D.A., Flohrs A., Riese J., Lamb C., Zerfu E.	In-depth Assessment of the Public Agricultural Extension System of Ethiopia and Recommendations for Improvement. IFPRI Discussion Paper 01041	2010
5	Dercon S., Gilligan D.O., Hoddinott J., Woldehanna T.	The impact of agricultural extension and roads on poverty and consumption growth in fifteen Ethiopian Villages	2009
6	Elias A., Nohmi M., Yasunobu K., Ishida A.	Farmers' satisfaction with agricultural extension service and its influencing factors: A case study in north west Ethiopia	2016
7	Gebrehiwot T., van der Veen A.	Coping with Food Insecurity on a Micro-Scale: Evidence from Ethiopian Rural Households	2014
8	Gebremedhin B., Jaleta M., Hoekstra D.	Smallholders, institutional services, and commercial transformation in Ethiopia	2009
9	Krishnan P., Patnam M.	Neighbors and extension agents in Ethiopia: Who matters more for technology adoption?	2014
10	Ragasa C., Berhane G., Tadesse F., Taffesse A.S.	Gender Differences in Access to Extension Services and Agricultural Productivity	2013

11	Shiferaw A., Sehai E., Hoekstra D., Getachew A.	Enhanced knowledge management: Knowledge centers for extension communication and agriculture development in Ethiopia	2012
12	Spielman D.J., Byerlee D., Alemu D., Kelemework D.	Policies to promote cereal intensification in Ethiopia: The search for appropriate public and private roles	2010
13	Spielman D.J., Davis K., Negash M., Ayele G.	Rural innovation systems and networks: Findings from a study of Ethiopian smallholders	2011
14	Spielman D.J., Kelemwork D., Alemu D.	Seed, fertilizer, and agricultural extension in Ethiopia	2012
15	Tefera D.A., Bijman J., Slingerland M.A.	Agricultural Co-Operatives in Ethiopia: Evolution, Functions and Impact	2017
		Reviewed political extension literature	
1	Abbink J.	Ethnic-based federalism and ethnicity in Ethiopia: Reassessing the experiment after 20 years	2011
2	Adem T.A.	The Local Politics of Ethiopia's Green Revolution in South Wollo	2012
3	Berhanu K., Poulton C.	The Political Economy of Agricultural Extension Policy in Ethiopia: Economic Growth and Political Control	2014
4	Clapham C.	The Ethiopian developmental state	2018
5	Cochrane L., Tamiru Y.	Ethiopia’s Productive Safety Net Program: Power, Politics and Practice	2016
6	Emmenegger R.	Decentralisation and the Local Developmental State: Peasant Mobilization in Oromyia, Ethiopia	2016
7	Lavers T.	'Land grab' as development strategy? The political economy of agricultural investment in Ethiopia	2012
8	Lefort R.	Free market economy, 'developmental state' and party-state hegemony in Ethiopia: The case of the 'model farmers'	2012
9	Makki F.	Power and property: commercialization, enclosures, and the transformation of agrarian relations in Ethiopia	2012
10	Malara D.M., Boylston T.	Vertical Love: Forms of submission and top-down power in orthodox Ethiopia	2016
11	Matouš P., Todo Y., Mojo D.	Roles of extension and ethno-religious networks in acceptance of resource-conserving agriculture among Ethiopian farmers	2013
12	Planel S.	A view of a bureaucratic developmental state: Local governance and agricultural extension in rural Ethiopia	2014
13	Rahmato D.	The peasant and the state	2008
14	Segers K., Dessein J., Hagberg S., Develtere P., Haile M., Deckers J.	Be like bees - The politics of mobilizing farmers for development in Tigray, Ethiopia	2009

Annex II Definitions of variables

Short title	Definition	Type of variable
Adoption index	The adoption index measures the intensity of adoption at the time of the survey and is calculated as follows: $$ALi = \sum_{i=1}^{n}\left(\frac{SA}{SR} + \frac{FA}{FR} + \frac{PFA}{PFR} + \frac{MPA}{MPR} + \frac{LCCS}{LCTS}\right)\mathbf{NP},$$ Whereby AIi= adoption index of the ith farmer, I= 1, 2, 3….n; =total number of respondents, SA= seed rate applied per hectare and SR= recommended seed rate per hectare, FA= fertiliser rate applied per hectare and FR= recommended fertiliser rate per hectare, PFA= ploughing frequency applied and PFR= recommended ploughing frequency, MPA= method of planting applied and MPR= recommended method of planting, LCCS= land covered by improved seed, LCTS= land covered by total seed and NP=package component (Dumara 2017).	Continuous
Distance to town market	The distance of the household to the closest market town in km.	Continuous
Education level	Level of education: no education (0), informal education (1), primary (2), secondary (3) and tertiary education (4). For the binary variable all respondents with no education are given value 0 and those with any education are given value 1.	Continuous and Binary
Eigenvector centrality	Relative scores are assigned to all nodes in the network based on the concept that connections to high-scoring nodes contribute more to the score of the node in question than equal connections to low-scoring nodes.	Continuous
Experience in malt barley cultivation	Number of years the individual household head has been engaged in barley cultivation.	Continuous
Family size	Total number of family members living and eating at the respective household.	Continuous
Frequency of contact with extension	The frequency that the respondent has had contact with an extension agent in the past year: (0) never, (1) once a year, (2) a few times per year, (3) every month, (4) more than every month. Binary: those with score 3 and 4 were considered as respondents with frequent contact; those with 0, 1 or 2 with less frequent contact.	Categorical and Binary
Land size	Total land size of household in hectare.	Continuous
Membership of cooperative	Whether the respondent is a member of the malt barley producer cooperative.	Binary

Participation in field day on malt barley	Whether the respondent has participated in a field day on malt barley in the past five years, and the number of times the respondent has participated in the past 5 years.	Binary and Continuous
Social status	This variable is a combination of 4 dummy variables. Respondent has, in the past five years, had a close relative or occupied a position in: Kebele management; government (district or higher); local church leadership; royal family/influential clan. The range of values for this variable was thus between 0 (none) and 4. All respondents with a total value of 2 or more were considered to have a high social status[18].	Binary
Tropical livestock unit	Total livestock units that the farmers owned in 2016 production season, according to IFPRI's conversion method (IFPRI 2015).	Continuous
Adoption of input related components of malt barley package	This variable is a combination of 3 dummy variables: whether the farmer used the recommended source of malt barley seed (from the government or cooperative, not self-saved, exchanged or purchased at the local market); whether the respondent applied DAP whether the respondent applied UREA. The range of values for this variable was between 0 (non) and 3 (all). Respondents with a total value of 2 or higher were considered as respondents with a high uptake of input related components, while respondents with a total value of 0 or 1 were considered as respondents with a low uptake of input related components[19].	Binary

[18] This variable was developed in close collaboration with local resource persons and validated during the fieldwork in 2016 in the study site.
[19] This variable was developed in close collaboration with local resource persons and validated during the fieldwork in 2016 in the study site.

Annex III Financial statement

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Front cover: Picture taken by Nina de Roo on a field in Emajar, Ethiopia, 2016

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Annex IV Completed Training and Supervision Plan

Wageningen School of Social Sciences (WASS)

Name of the learning activity	*Department/Institute*	*Year*	*ECTS**
A) Project related competences			
Basic statistics	PE&RC	2014	1.5
Qualitative data analysis	WASS	2017	2.5
Quantitative research methodology and Statistics MAT22306	WUR	2017	6
B) General research related competences			
Introduction course	WASS	2018	1
Research Methodology: From topic to proposal	WASS	2014	4
Writing research proposal	WASS	2014	6
'Trials for development impact? The organization of on-farm trials for scaling agricultural technologies in AR4D'	Contested Agronomy, IDS, Sussex	2016	1
'On-farm trials for development impact? The organisation of research and the scaling of agricultural technologies'	Plant Production Systems (WUR)	2017	1
'The socio-political dimension of agricultural extension in Ethiopia'	WCDI (WUR)	2020	1
C) Career related competences/personal development			
Convening a session at the Wageningen PhD Symposium	Wageningen PhD Council	2018	1
Teaching Technology, Agro-ecology and Development	WUR	2019	1
Teaching Critical Reflection on Research in International Development	WUR	2020	1
ACT coach	Competence studies	2019	2
Reviewer of paper called 'On-farm trials identify adaptive management options for rainfed agriculture in West Africa'	Agricultural Systems	2020	1
Reviewer of paper called 'The role of gender relations in technology adoption: The case of sweet potato vine multiplication in Phalombe and Chikwawa districts in Malawi'	Wageningen Journal of Life Sciences	2017	1
Total			31

*One credit according to ECTS is on average equivalent to 28 hours of study load