Social capital, agricultural innovation and the evaluation of agricultural development initiatives

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Chapter 1 Introduction

1.1 Background

Agricultural development is considered an important, if not necessary, condition for alleviating poverty around the world (e.g. Duflo and Kremer 2005; World Bank 2007; De Janvry 2010; Diao et al. 2010; Christiaensen et al. 2011: 486). An estimated 75% of the world's poor live in rural areas and depend on agricultural or related activities for their livelihoods (World Bank 2007). Moreover, the agricultural sector is the backbone of many developing economies. In 2012, agriculture provided 30% of GDP in low income countries (World Bank 2012). Considering the important contribution of small-scale producers to this sector, growth in GDP from the agricultural sector might be more pro-poor than growth in other sectors. In fact, Christiaensen et al. (2011) show that growth in agriculture is especially favourable for the poorest of the poor.

Despite the importance of agriculture, Official Development Aid (ODA) invested in agriculture has decreased dramatically since 1980. This change was mainly inspired by the "dual economy" models where the development of the agriculture sector is viewed to come at the cost of the development of a more productive, progressive and dynamic industrial sector (Christiaensen et al. 2011). However, after the turn of the century agriculture was brought back on the development agenda.

This increased interest in agriculture was mainly inspired by the increasing pressure on the agricultural sector for increased food quantity and quality (Godfray et al. 2010). In fact, in 2009 the G8 member nations agreed that the decrease in ODA investment in the agricultural sector had to be reversed in order to address the persistence of food insecurity. Even though official ODA spending is still lower than in the 1980s, the share of ODA spent on agriculture has begun to increase again in 2007, as did the absolute share of government spending in developing countries (Lowder et al. 2012). Consequently many development agencies invest their resources in the agricultural sector.

Parallel to the revived investment in agriculture has been an increased interest in measuring the impact of these investments, and of development aid more generally (Duflo and Kremer 2005; Deaton 2009; De Janvry 2010). Two of the most apparent reasons why impact

evaluation takes place is to account for resources used and to generate knowledge to improve the design and implementation of future programs (Mackay and Horton 2003). The literature contains several suggestions to improve not only the quality of impact assessment but also its usefulness in practice. First, more attention should be paid to differences in impact across different groups and to gain insight into what determines these differences in impact (Deaton 2009). Second, impact evaluation should more explicitly state the pathways through which impact is to be expected (Mackay and Horton 2003). Stating such impact pathways helps forming beliefs about causal linkages between inputs, outputs and impacts, and the mechanisms linking them. The mechanisms of impact can be adapted to other situations rather than the exact outputs, outcomes or impacts as such (Hawkins et al. 2008; Deaton 2009). Third, more attention should be given to address the institutional context in which development initiatives are implemented (e.g. Mackay and Horton 2003; Raina 2003). This is in line with the large literature that identifies institutions as a key factor in development (North 1990; Williamson 2000; Rodrik et al. 2004). Finally, impact should not be attributed to individual agents, but rather to the characteristics of the network of agents involved (Ekboir 2003). This especially applies to initiatives that focus on agricultural development and innovation. Therefore, to improve the quality and usefulness of impact assessment for development interventions, it should be realized that impact results from a combination of the mechanisms, the institutional context and the agents involved.

One of the factors that can be used to capture this complexity in impact evaluation is social capital. Intuitively, social capital can be understood by the idea that the people around you are an important asset that can be "called upon in a crisis, enjoyed for its own sake, and/or leveraged for material gain" (Woolcock 2010). A large literature identifies social capital as a factor conducive to growth and development at macro and micro level (Knack and Keefer 1997; Narayan and Pritchett 1999; Zak and Knack 2001; Fafchamps and Minten 2002; Grootaert and Bastelaer 2002; Isham 2002; Karlan 2005; Ahlerup et al. 2009; Baliamoune-Lutz and Mavrotas 2009).

From an early stage, social capital theory has been criticized for being an elusive concept without clear guidelines for measurement (e.g. Mansuri and Rao 2004; Durlauf and Fafchamps 2005; Poder 2011). Robison et al. (2002) conclude that many of these criticisms arise from the fact that scientist have mixed up social capital with what it determines, where it resides or what it can be used for. In "The rise and routinization of Social Capital, 1988-2008" Woolcock (2010) argues that these criticisms might be inherent to the concept and we should

not aim for a common definition. He refers to the term "essentially contested concepts" from Gallie (1956) to emphasize that the utility of the concept lies in facilitating constructive discussion on the importance of social relationships, rather than on forging consensus on how it is defined exactly. Indeed, the number of articles with reference to social capital and development continued to rise until 2012 (Scopus search results "Social Capital" & "Development").

In this thesis, I broadly define social capital as the participation of individuals in formal and informal networks, the norms that define these networks and the trust these individuals have within and outside these networks. I distinguish between structural and cognitive social capital (Uphoff and Wijayaratna 2000) and between bonding and bridging social capital (Putnam 2000). Cognitive and structural social capital refer to the type of social capital used: norms and trust are cognitive social capital, whereas formal and informal networks are structural social capital. Bonding capital refers to ties between people with similar characteristics, and bridging social capital refers to ties across different groups.

One area where social capital, impact evaluation and agricultural development meet is in agricultural innovation. Agricultural innovation is widely viewed as an important factor for economic growth and development of developing countries (Bhandari and Yasunobu 2009; World Development Report 2009). Agricultural innovation can have a direct influence on poverty by increasing productivity, decreasing production cost, or reducing risk for those adopting (De Janvry and Sadoulet 2002). Moreover, it can have an indirect effect on poverty by lowering food prices, creating employment opportunities or stimulating the non-farm economy (De Janvry and Sadoulet 2002). In this thesis, I investigate the link between social capital and improved land and crop management practices, an important area of agricultural innovation for small scale producers.

It is increasingly recognized that agricultural innovation does not happen in isolation. Rather it is "the outcome of collaborative networks where information is exchanged and learning processes happen" (Knickel et al. 2009). Such notions of networks and interconnectedness gave way to the "innovation systems" view. This view stipulates that agricultural innovation results from the integration of knowledge from various actors and stakeholders, implying a focus on interdependence, networks, learning, and social interaction (Leeuwis and Ban 2004; Röling 2009). This shift in the interpretation of innovation is clearly characterized by an increasing importance of networks, norms and trust, and thereby the concept of social capital. In fact, one of the potential channels via which social capital affects

poverty is through adoption of improved agricultural practices (e.g. Narayan and Pritchett 1999; Isham 2002; Bandiera and Rasul 2006).

Considering the important role of social capital for development, agricultural or otherwise, many development initiatives increasingly pay attention to the importance of social capital. Many development initiatives aim to enhance economic development indirectly by promoting cooperation in networks and by encouraging trust and norms of behaviour that involve mutual beneficial action. Mansuri and Rao (2004) estimated that the World Bank alone increased its lending to "community driven" and "participatory" projects from $325 million in 1996 to $2 billion in 2003. These projects include beneficiaries in the design and management of the project and stress the importance of information sharing, capacity building, and strengthening the civic societies that represent them (Mansuri and Rao 2004). In many projects in the agricultural sector these characteristics are also evident.

However, it is far from clear whether external development initiatives can actually influence social capital, especially in the short term. Many authors argue that social capital is a result of long-term historical processes (Bowles and Gintis 2001; Nunn and Wantchekon 2011). On the other hand, some empirical evidence also indicates that social capital can be influenced (e.g. Bebbington and Carroll 2002; Krishna and Uphoff 2002), even in the short term (Fearon et al. 2009; Labonne and Chase 2011). On balance however, social capital research has been more successful in documenting its potential role in development than identifying whether, how, and to what extent external initiatives can contribute to social capital accumulation (Grootaert and Bastelaer 2002).

Moreover, it is unclear to which extent the existing level of social capital matters for the success of development initiatives (Isham and Kähkönen 2002; Mansuri and Rao 2004; Deaton 2009). When we view agricultural innovation as part of an innovation system, the impact of these initiatives might depend quite extensively on the existing level of social capital. However, there is still a lack of understanding regarding the influence of social capital in agricultural innovation (Landry et al. 2002; De Hoop and Van Kempen 2010).

Two examples of initiatives where social capital is important, and that form the empirical basis of this thesis, are the implementation of agricultural research at farm level through interactive, multi-stakeholder innovation platforms (FARA 2009), and the implementation of sustainable certification schemes through group-based experimental learning approaches. The first initiative, and the one upon which most of this thesis is based, adopted the Integrated Agricultural Research for Development (IAR4D) perspective as its

main approach in eight Sub Saharan African countries. The core of this approach is the development of Innovation Platforms (IPs), which can be described as an informal coalition and alliance of conventional agricultural research and development actors. The second initiative relates to four sustainable coffee projects implemented in Vietnam, of which two adopted the interactive Farmer Field School training approach.

It is important to highlight that these development initiatives, and many other, make implicit or explicit assumptions on the role of social capital. Yet, there is little evidence on the relationships between social capital, agricultural innovation and development initiatives. This is crucial for development initiatives that try to foster social capital, or at least to prevent these same initiatives from undermining it. An improved understanding is also crucial for those initiatives that rely on existing levels of social capital for the success of their initiatives. This dissertation enriches the academic debate in a twofold manner. The first contribution is theoretical by identifying the relationship between social capital and agricultural innovation. The second contribution is empirical and methodological by testing these relationships in multiple development initiatives using several dimensions of social capital.

1.2 Objectives and research questions

From the background section it becomes clear that social capital is an important factor in economic development. Yet it is still unclear whether enhanced agricultural innovation is one of the mechanisms through which this effect materializes, and to which extent social capital is important for development initiatives that aim to enhance agricultural innovation. In this thesis, I argue that social capital is important for these initiatives in at least three ways. First, (i) social capital can influence the level of agricultural innovation. Second, (ii) development initiatives trying to stimulate agricultural innovation can influence social capital. Third, (iii) the existing level of social capital can influence the success of these initiatives.

Therefore, the main objective of this thesis is to understand and investigate different ways in which social capital matters for development initiatives that aim to enhance agricultural innovation. I formulate three research questions:

1. How are social capital and agricultural innovation related?
2. Can development initiatives increase agricultural innovation by building social capital?

3. Does the initial level of social capital increase the success of these development initiatives in enhancing agricultural innovation?

The relationships between the different research questions and the chapters in which they are addressed are depicted in figure 1. Please note that I do not address the relationships implied by the dashed arrows. Furthermore, the arrows in the figure depict hypothesized causality but do not indicate that I addressed this for all relationships. Considering the data at hand, I rely on associations rather than causal relations for chapter 3 and 6, and partly for chapter 5 and 7.

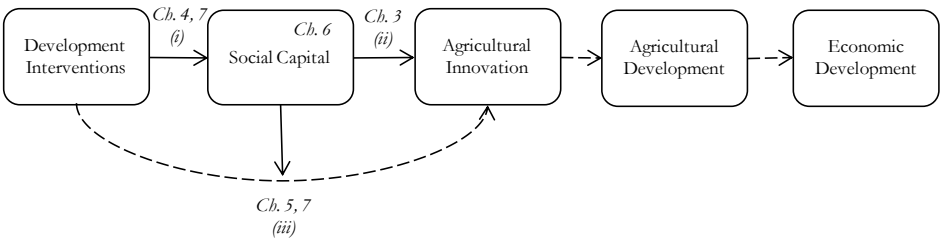

Figure 1: relationship between the different concepts, research questions, and chapters

1.3 Outline

This thesis is structured into eight chapters, including this introductory chapter.

In chapter 2, I elaborate on the main concepts underlying this thesis including social capital, how it relates to development initiatives in the agricultural sector, and how it can be measured. In chapter 3 until chapter 6, I use data collected by the Sub Saharan African Challenge Program (SSA CP) to empirically test these relationships.

In chapter 3, I investigate the link between social capital at village level and agricultural development in the three African sub-regions; (i) the border region between Rwanda, Uganda and the DRC, (ii) the central border region between Nigeria and Niger; and (iii) various sites in Zimbabwe, Mozambique and Malawi. I use baseline data from the IAR4D initiative collected among more than 2500 households. I find that structural bridging social capital is associated with more extensive adoption of agricultural innovations, while the reverse is true for cognitive bonding social capital.

In chapter 4, I narrow my focus to the border region between Rwanda, Uganda and the DRC. Because the IAR4D data set consist of randomized data of participating and none

participating villages, before and two years after implementation, I can investigate the impact of the program. I show that IAR4D has had an impact on structural bridging social capital in DRC and Uganda. There was no significant impact on structural bridging social capital in Rwanda, or on the other dimensions of social capital.

In chapter 5, I use data from a survey I conducted among IP coordinators to measure the extent to which IPs were implemented according to the principles of IAR4D across the three sub regions. Linking these data to the main survey data, I find that the "IAR4Dness" index is associated with the success of IAR4D in increasing the level of household food security, although not through increased adoption of agricultural innovation or increased levels of social capital at the household level. I also find tentative evidence that the IAR4Dness index can be explained by the initial level of social capital at village level.

In chapter 6, I make a methodological contribution to the social capital literature by analysing how different indicators used to represent social capital are related in the border region between Rwanda, Uganda and DRC. I focus on the relationship between various indicators of trust, an important component of cognitive social capital, and group membership, an important component of structural social capital. These data are based on questions I added to the follow up survey in 2010. I find that the two components cannot be empirically captured by an overarching social capital factor, and are not even necessarily associated to each other.

In chapter 7, I present evidence that the relationship between social capital and agricultural innovation is not only evident for the IAR4D, but also for a different development imitative in a different context: sustainable coffee certification in Vietnam. I use data collected among 240 randomly selected project participants and 150 comparable farmers that did not participate in the projects. I focus on the role of bonding and bridging cognitive social capital, defined as trust. I find a significant positive association between trust and the uptake of sustainable agricultural training practices. This effect mostly stems from bridging trust, and is even higher in combination with high levels of bonding trust. I also find tentative evidence that participation in the sustainable coffee projects positively influenced bonding trust in one project whereas it negatively influenced bridging trust in another project.

In chapter 8, I summarize the main findings, discuss the implications for policy and research, and offer some recommendations for future research.

Chapter 2 Social capital, agricultural innovation and development initiatives

In this chapter, I introduce and discuss the concept of social capital and its relationships to agricultural innovation and development initiatives. In section 2.1, I give a brief overview of the history of social capital. In section 2.2, I discuss the definition, level and types of the concept of social capital and elaborate how I define it in this thesis. In section 2.4, I introduce development initiatives as a potential determinant of social capital. In section 2.3, I discuss the consequences of social capital by linking social capital to economic development and agricultural innovation, and I introduce social capital as a potential catalyst for the success of development initiatives. In section 2.5, I give an overview of how social capital can be measured, followed by a conclusion in section 2.6.

2.1 History and critique

For many years standard economic theory ignored the role of socio-cultural factors in explaining economic growth. Instead rational choice models, such as Solow growth models and the Walrasian equilibrium model, were to account for all economic variation within and between countries. Over time this simplistic view was criticised in various ways (Bhandari and Yasunobu 2009). Economist failed to explain differences in economic performance and the negative externalities associated with it, such as inequality or environmental degradation. Furthermore, they failed to account for social value systems assuming human beings are rational and that their utility-maximizing behaviour is the same everywhere.

By the end of the 1990s it became more generally accepted by economist that " economic activity is deeply embedded in the social structure, and agents' decisions are influenced by a wide range of social and cultural factors" (Gugerty and Kremer 2002:1). Following the influential work by Bourdieu (1986), Coleman (1988), Putnam (1993) and Fukuyama (1995), the concept of social capital became increasingly used to capture such factors. Woolcock (2010) identified at least nine fields of studies where social capital has played an important role: families and youth behaviour problems, crime and violence; schooling and

education, community life, work and organisations, democracy and governance, collective action problems, democracy and governances, and economic development.

However, the development of the concept of social capital has also led to criticism. First, several authors argue that social capital should not be labelled a capital at all, because it does not fulfil some of the essential characteristics of capital. For example, Arrow (2012) argues that social capital is not a capital because it is not transferable in terms of ownership and does not require a deliberate sacrifice for future benefit. Second, many authors refer to critiques of measurement, where the literature mixes up social capital with what it determines, what its consequences are or where it resides (Robison et al. 2002). Research that uses the outcomes of social capital as an indicator, such as voter turnout or blood donation (Guiso et al. 2004) necessarily find it to be related to that outcome. Third, empirical models including social capital are often problematic because social capital is not exogenous to the model; it is correlated with unobserved factors, it is reverse-caused by current economic factors, or it reflects the working of institutions (Guiso et al. 2010). Fourth, the potential harm of social capital is not always recognized. For example, strong intra-group social capital can be associated with conservatism and conformity (e.g. Dakhli and De Clercq 2004; Kaasa 2009) or conflict with the interests of wider society (Knack and Keefer 1997; Bowles and Gintis 2001). Finally, some argue for a more complex interpretation of social capital, where it should be viewed as "a deeply contextual and endogenous construct" (e.g. Mansuri and Rao 2004:10). By simply aggregating indicators of social capital at community or even country level the indicator can easily lose its contextual value (Sabatini 2005). The definition of social capital and the way in which it is measured thus remains very incoherent (Sabatini 2005). This also implies that it is challenging to synthesize the outcomes of social capital research.

Some of these criticisms have been addressed in the literature and some are addressed in this thesis. For example, Robison et al. (2002) give a convincing overview of why some forms of social capital should indeed be labelled capital. They argue that social capital is transformable to other services, possesses different degrees of durability, can be flexible or inflexible, is subject to decay, can be transposed to other capitals and has opportunity cost related to investment. Also, it is increasingly recognized that social capital is a multidimensional concept, and it is measured as such by a limited but increasing number of authors (also see chapter 4 and chapter 5). Yet, it is still unclear how the different components are related to each other (e.g. Claibourn and Martin 2000, Quibria 2003, chapter 6). Despite the criticism and conceptual vagueness social capital remains an important construct maybe because, as

Woolcock (1998) argued, it is in this concept that scientist from many different disciplines have once again found a "common language". Indeed, social capital has become a well-known concept and is used in scientific and policy-related discussions.

2.2 Social capital defined

Based on a recent literature review, Bhandari and Yasunobu (2009: 486) summarise social capital as "a multidimensional phenomenon encompassing a stock of social norms, values, beliefs, trusts, obligations, relationships, networks, friends, memberships, civic engagement, information flows, and institutions that foster cooperation and collective actions for mutual benefits and contributes to economic and social development". This broad definition probably already took its roots in the various ways in which social capital was used by early researchers. Bourdieu (1986) for example stressed the importance of social networks; Fukuyama (1995) that of trust and norms of cooperation; and Coleman (1988) defined social capital by its function, i.e. an aspect of social structure that facilitates action of the individuals within (see Bhanderi and Yasunobu for an overview of different views). In this thesis, I broadly define social capital as the participation in formal and informal networks, the norms that guide behaviour in these networks and the trust within and outside these networks.

The imprecise definition of social capital makes it unclear whether social capital resides at the individual or collective level. Even though social capital is something which exists between people, it has a clear individual attribute (Poder 2011). Moreover, when social capital is defined at collective level, the question arises as to what defines the collective (Lancee 2012). Different networks are clearly overlapping and some individuals might have a more central role, and thus benefit more, than others. In this thesis, I consider network participation and trust as individual attributes of social capital, which may or may not be aggregated at village level. The norms of cooperation I include in chapter 3-5 are shared village norms.

Social capital can be classified along two well-known dimensions: bonding versus bridging social capital (Putnam 2000) and cognitive versus structural social capital (Uphoff and Wijayaratna 2000). Bonding social capital refers to ties between people of similar characteristics and is essentially horizontal in nature. Bridging social capital refers to ties across different groups and often across different power lines, thereby being essentially vertical in nature. In this thesis, I classify ties inside the village as bonding social capital, and ties between villages and in institutions as bridging social capital. Cognitive and structural social capital on the other hand refer to the type of social capital used. Norms and trust form the cognitive of social

capital whereas formal and informal networks form the structural social capital. Considering the exploratory nature of this thesis, I consider four dimensions of social capital: structural bonding, structural bridging, cognitive bonding and cognitive bridging

2.3 Social capital and its determinants

As was argued in section 1.1, many community driven and participatory projects can be seen as efforts to enhance economic development indirectly by stimulating cooperation in formal or informal networks, and by stimulating trust and norms of behaviour towards mutual beneficial action (arrow A, Figure 1 in chapter 1). Most of these projects have their foundation in the "community-driven development" approach; an umbrella term for projects and programs that actively include their beneficiaries in processes such as design, management and evaluation. This is also apparent in one of the initiatives investigated in this thesis (chapters 4 and 5): the Integrated Agricultural Research for Development (IAR4D) approach as adopted by the Sub Saharan African Challenge Programme (FARA 2004). The core of the approach relies on Innovation Platforms (IPs) which, although operating at various administrative levels, are positioned at the local governmental level and are active at the village level. They represent an institution that brings together stakeholders in the agricultural sector, including farm households, local government agencies, scientist, NGOs and traders. To abide with the IAR4D approach, the IPs have to fulfil several criteria that stipulate that IPs should, amongst others, be diverse, representative, collaborative, participatory and set their own priorities (Hawkins et al. 2008). This illustrates that the main aim of IAR4D is not to directly influence certain development outcomes (e.g. agricultural innovation or income), but to create a setting to enable these outcomes.

In a critical review, Mansuri and Rao (2004) show that the evidence on the effectiveness of the community driven development approach is very limited. Therefore, it is unclear whether the benefits of social capital community driven development initiatives try to stimulate - i.e. reducing information problems, expanding resources available to the poor and strengthening the organisations that represent them - is actually successful. Some even argue that the rapid expansion of these projects has resulted in severe waste of development resources (Yujiro 2009).

More generally speaking, it is still a topic of debate whether external initiatives can actually influence social capital, especially in the short term. A large literature suggest that social capital is historically derived (Putnam 1993), is a result of long-run evolutionary process

(Bowles and Gintis 2001) or shaped by critical junctions in history such as the extraction of slaves from Africa (Nunn and Wantchekon 2011). Others have empirically verified that development assistance was not successful in enhancing social capital. Gugerty and Kremer (2002) show that a program in Kenya was unsuccessful in enhancing participation of marginalized women, their target group, in community associations. Instead the program resulted in higher participation of men and educated younger women, and less participation of older women. In a recent study, Casey et al. (2012) exploit the random assignment of a community driven development program in Sierra Leone. Even though the program improved local public goods and economic outcomes, there was no effect on the social capital indicators the program targeted including collective action, decision making, or the involvement of marginalized groups.

That does not mean social capital cannot be created. An increasing number of studies indicate that social capital can in fact be influenced by external initiatives, even on the short term. A number of studies suggest social capital can be influenced by development initiatives in the short term (Uphoff and Wijayaratna 2000; Bebbington and Carroll 2002). Using a clustered randomized trial Pronyk et al. (2008) show that a group-based microfinance project combined with participatory training on HIV and gender was successful in creating higher levels of social capital after two years. Work by Fearon et al. (2009), using a randomized field experiment to analyse the impact on community reconstruction groups, supports this.

It should be noted that social capital, like most capitals, is also susceptible to degradation. Degradation could for example result from intrastate conflict (Colletta and Cullen 2002). Likewise, it can be argued that external initiatives, such as development programs, can degrade existing social relations, trust or norms of cooperation (also see chapter 7). Gugerty and Kremer (2002) for example demonstrate that encouraging collective action, in a women's group program, created opportunities for rent seeking and actually weakened existing social capital (also see Mansuri and Rao 2004).

2.4 Social capital and economic development

There has been an enormous increase in empirical literature measuring the economic benefits of social capital. Classical examples in the economic development literature are the cross sectional country studies by Knack and Keefer (1997) and Zak and Knack (2001) in which certain dimensions of social capital are used to explain differences in economic development. Also at micro level, there has been an increase in the use of social capital as an explanatory

variable in issues such as household income (Narayan and Pritchett 1999), agricultural innovation (Isham 2002; Bandiera and Rasul 2006), access to credit (Besley et al. 1993) or transaction costs (Fafchamps and Minten 2002).

Depending on the way social capital is defined, or the theoretical perspective one chooses, different mechanisms of impact are identified. From a typical economic rational choice perspective, social capital becomes an input in the utility or production function (Gugerty and Kremer 2002). The effects would be modeled in similar ways as other factors that reduce transacation or production cost. The argument underlying this theory is that social capital provides the structure required to maintain beliefs of mutual expectations about reputation and rules of behavior (Dasgupta 2005). Granovetter (2005) summarisis four core principles how social capital, which he refers to as social ties and networks, are linked to economic outcomes from a sociological theory perspective. First of all, dense social networks help to overcome free rider problems in collective action. In dense networks norms of behaviour are clearer and easier to enforce. Second, weak social ties enhance the flow of novel information, and thus innovation. This is referred to as the so-called "strength of weak ties". Third, and related to this, is the position specific individuals have in a network by bridging the gap between different groups, referred to as "structural holes". Fourth, economic and non economic actions are often interlinked. This is referred to as the "social embeddeness" argument and implies that the cost of economic action depends on non-economic institutions and processes. Using these principles Granovetter explains the link between social networks and labour markets, prices, compliance, productivity and innovation - the latter being the focus of this thesis (chapter 3 and 7).

I argue that enhanced agricultural innovation is one of the mechanisms through which social capital materializes in economic impact (arrow B, Figure 1 in chapter 1). Innovation results from the integration of knowledge from various actors and stakeholders, implying a focus on interdependence, networks, learning, and social interaction (Leeuwis and Ban 2004; Röling 2009; Conley and Udry 2010). Social capital contributes to an innovative milieu (Dakhli and De Clercq 2004) and becomes a "factor of innovation" (Kaasa 2009). For example, participation in formal and informal networks is expected to facilitate the exchange of information, create synergy among actors, and stimulate access to resources. Trust and shared norms can promote cooperation and coordination, and reduce transaction costs. Norms further help to prevent misunderstanding, which in its turn enhances productive cooperation

(Knack and Keefer 1997; Boahene et al. 1999; Bandiera and Rasul 2002; Isham 2002; Landry et al. 2002; Dakhli and De Clercq 2004; Kaasa 2009).

Social capital can also influence economic development indirectly by influencing the success of development initiatives (arrow C, Figure 1 in chapter 1). Various scholars identify the importance of social capital for the effectiveness of aid at macro level (e.g. Baliamoune-Lutz and Mavrotas 2009) or micro level (Isham and Kähkönen 2002; Mansuri and Rao 2004; Deaton 2009). Monge et al. (2008) for example show that households who are better embedded in social networks in rural Bolivia are more likely to adopt the agricultural innovations brought to them by various development initiatives. Another example is by de Hoop and van Kempen (2010) who find that households with higher levels of trust in health providers adopt more bed nets as provided by health providers.

The role of social capital as a catalyst for the success of development initiatives might be especially true for initiatives that try to enhance agricultural innovation through group processes. This is also evident in the development of IPs as part of the IAR4D approach (chapter 5). Another example investigated in this thesis relates to the role of trust in facilitating training uptake in sustainable coffee initiatives (chapter 7). If a certain country, region or group of people is generally not inclined to cooperate and faces overall low levels of trust, for example as the result of ethnic conflicts or corruption, it might be hard to develop a program that requires cooperation or trust from the very first stage. It can therefore be argued that the existing level of social capital is essential in the success of these programs.

At the same time it should be realized that social capital does not necessarily have positive outcomes for economic development, agricultural innovation, or for initiatives that depend on its initial level for success. Quibria (2003) summarizes four downsides of social capital. First of all, while creating opportunities for those inside the network, it can also create barriers for those outside the network. Second, social capital in combination with norms of redistribution can prevent incentives to accumulate capital or successful entrepreneurship. Third, high levels of, especially bonding social capital can promote conformity to existing ways and thereby reduce innovative behaviour (also see chapter 3). Fourth, strong social capital can also be used to maintain bad equilibriums of norms and values. Clearly these downsides also apply to development initiatives that implement their programs in communities with high levels of bonding social capital.

2.5 Measuring social capital

One way to measure social capital, and probably the one most often used, is by conducting surveys. Survey measures of social capital are very diverse and cover structural and cognitive indicators of social capital. Measures vary from single proxy indicators of associational activity to inclusive sets capturing information and communication, groups and networks, trust and solidarity, collective action and cooperation, social cohesion and inclusion, and empowerment and political action (Grootaert et al. 2004). Others, like Kaasa (2009), identify measures of social capital using a factor analysis. His 6 factors are based on 20 indicators and associated with general trust and networks, institutional trust, norms of helping and decency, norms of active social participation, norms of orderliness and civic participation. Grootaert and Bastalaer (2002) categorise the variety of social capital indicators used into three types of proxies: membership in local associations and networks, indicators of trust and adherence to norms, and indicators of collective action. This diversity results from the multidimensional character of the concept and the variety of definitions used (see section 2.2).

Another way to measure social capital is by experimental games. Experimental games are particularly useful to capture the cognitive dimension of social capital including trust, trustworthiness and norms of cooperation. These experimental games include trust games (e.g. Glaeser et al. 2000; Karlan 2005), ultimatum games (e.g. Carpenter 2002) and public goods game (e.g. Anderson et al. 2004). The trust game is designed to measure trust by the amount of money passed on from player A to player B, and trustworthiness by the amount passed back to player A after this amount has been increased by a third party. In the ultimatum game player B can either accept or reject the proposed distribution of a certain amount of money by player A, and is set up to measure fairness. The public goods game is designed to capture group norms of cooperation by creating an incentive to invest money in the group account rather than the individual account.

Both methods have advantages and disadvantages (see Carpenter 2002 and Guiso et al. 2010 for an overview). The main critique on survey questions is that they do not provide the right incentive to report true behaviour or attitudes. This is especially true for questions related to the cognitive dimension of social capital. In contrast, experiments measure actual behaviour rather than self-reported behaviour. However, participants in experimental games might also present more pro-social behaviour to give a good impression to the experimenter. The main critique on experimental games involves their external validity; it is unclear how the setting

created in the game replicates real life situations and to which extent the respondents are representative for the entire population. The different methods, but also different questions and games, clearly result in different indicators of social capital. Therefore, it remains a topic of debate whether or not the measures from experiments and surveys are related, and which ones better capture social capital (Guiso et al. 2006; Guiso et al. 2010; Thöni et al. 2012).

In this thesis, I rely on surveys to measure social capital because it allowed me to capture social capital among a large population and across all dimensions of social capital. Thus far few authors recognize the multidimensionality of social capital in their empirical measures (also see chapter 4 and 5). This is partly caused by the sometimes conflicting effect social capital can have on economic development (chapter 3) and the lack of theoretical or empirical arguments linking the different dimensions and indicators to each other (chapter 6).

2.6 Summary

In this thesis, I broadly define social capital along three types of indicators: (i) the participation of individuals in formal and informal groups, (ii) the norms that define cooperation in these groups, and (iii) the trust individuals have within and outside these groups. All these indicators are considered social capital as such; rather than what it determines (e.g. development initiatives) or what its consequences are (e.g. agricultural innovation or leveraging the impacts of development initiatives). Because this is an exploration of the potential role of social capital for development initiatives, I chose not to limit the study to one specific type of social capital. Instead, I focus on four dimensions of social capital, being structural bonding, structural bridging, cognitive bonding and cognitive bridging. Except for norms, which are shared within a group, I consider group participation and trust as individual attributes of social capital. This may or may not be aggregated at a higher level depending on the purpose of the specific chapter. Where I largely consider the aggregate effect of social capital I define it at village level. All measures of social capital are based on surveys.

Chapter 3 Social capital and agricultural innovation in Sub Saharan Africa

Abstract: In this paper we use a novel and extensive dataset to explore the association between different forms of social capital and innovation in agriculture, for a sample of African countries. We find mixed evidence. While structural social capital, especially in the form of connections beyond the village, is associated with more extensive adoption of innovations, the reverse is true for cognitive social capital (capturing shared norms and trust within the local community).

Paper by Fédes van Rijn, Erwin Bulte and Adewale Adekunle published in the Journal of Agricultural Systems (2012): "Social capital and agricultural innovation in Sub-Saharan Africa" (2012). Agricultural Systems, 108, 112-122.

3.1 Introduction

A rapidly growing literature identifies social capital as a factor conducive to growth and development (e.g. Knack and Keefer 1997; Zak and Knack 2001). Positive growth effects may materialize via various channels, including reduced transaction costs (precluding the necessity to write contracts that capture all contingencies), facilitated exchange of information, and enhanced trust (enabling communities to overcome social dilemmas). A recent study by Ahlerup and Olsson (2009) suggests that social capital and formal institutions are substitutes in development, so that social capital is especially important for the poorest countries where formal institutions are of the lowest quality (for other treatments of the interaction between social capital and institutions, refer to Dasgupta 2005; and Tabellini 2005). Sub-Saharan Africa leaps to mind as an example of a region with strong social ties between community or kin members and weak (macro) institutions.

Indeed, and complementing the macro-style analyses mentioned above, micro analyses confirm the important economic role of social capital in Africa (Narayan and Pritchett 1999; Bigsten et al. 2000; Woolcock and Narayan 2000; Narayan and Cassidy 2001; Fafchamps and Minten 2002; Isham 2002; Misselhorn 2009). One of the potential channels via which social capital affects farmers' livelihoods is enhanced adoption of new agricultural technologies (e.g. Narayan and Pritchett 1999; Isham 2002; Bandiera and Rasul 2006).

Agricultural innovation is widely viewed as an important factor for economic growth and development in Sub Saharan Africa (World Development Report 2009). Yet agricultural innovation among smallholders has progressed slowly, and programs to promote the adoption of new technologies, even if occasionally successful locally, have largely proven unsuccessful. While many aspects of innovation remain poorly understood (see Landry et al. 2002 for an overview), some argue that an important cause of limited impact of traditional research and extension in Africa is the simplistic yet dominant view on innovation processes. Recent work emphasizes interdependence among actors, network effects, joint learning, and social interaction (e.g. Leeuwis and Ban 2004; FARA 2008; Röling 2009). According to this perspective, social capital and innovation are naturally linked.

The overarching objective of this paper is to analyse the role of social capital in the adoption of agricultural innovations for a large sample of African smallholders. To this end we aim to "unbundle" social capital, and distinguish between different dimensions of it. Prominently, this includes a distinction between structural and cognitive social capital, and

between bonding and bridging social capital (see below). As evident from the theoretical discussion that follows, not all dimensions of social capital are conducive to innovation. We are the first to explore this issue comparing a sample of different African countries. However, there are limits to what we can do with our data. The nature of our data (cross-section, non-experimental) implies that potential endogeneity concerns emerge (reverse causality, omitted variables). We are careful to emphasize that the results on these pages are correlations, and need not necessarily reflect causal relationships.

The paper is organised as follows. In section 3.2 we outline our theoretical framework and discuss the main concepts. In section 3.3 we introduce our data and empirical strategy. Section 3.4 presents our regression results, focusing on the association between different dimensions of social capital and innovation, as well as an extensive robustness analysis. The conclusions and discussion ensue in section 3.5.

3.2 Social capital and innovation

We defined social capital at community level and distinguish between cognitive and structural social capital (see sections 2.1 and 2.2). We also distinguish between bonding and bridging social capital (see section 2.2). Bonding capital refers to horizontal ties between people with similar characteristics – think of relationships among a group of farmers within a village. In contrast, bridging capital refers to ties across groups. Often such ties are vertical in nature – think of the relationship between the government or extension officers and farmers.

Besides quantifying social capital (see section 2.5 on measurement of social capital), analysts should try to relate it to economic behaviour or outcomes. In section 2.4 we introduced the idea that enhanced agricultural innovation is a potential mechanism via which social capital can impact economic development. Structural social capital can spur innovation via enhanced information flows and reduced transaction costs (e.g. Dakhli and De Clercq 2004; Kaasa 2009). Engagement in networks may also yield a synergy effect, as it fosters the combination of different ideas or skills, and a "realisability effect" due to enhanced access to different resources (including political or financial support). For evidence of the impact of structural social capital on innovation in developing countries, refer to Boahene et al. (1999) and Bandiera and Rasul (2006). Also in a developed country setting various studies confirm the leveraging role of structural social capital (see for example Landry et al. 2002; Kaasa 2009).

Cognitive social capital might matter for innovation as well. Trust can increase the overall tendency to cooperate and lower transaction costs (e.g., bargaining and decision cost, policing and enforcement cost). Moreover, sufficiently high levels of trust may allow groups of individuals to self-insure against risk. In the presence of informal insurance mechanisms – a key component of social capital – individual farmers are better able to adopt (potentially risky) innovations as downside risks can be overcome (Narayan and Pritchett 1999). Finally, it is easy to imagine how shared norms may affect innovation. According to Knack and Keefer (1997), norms may capture a general tendency of individuals to cooperate and subordinate self-interest to that of society. Like trust, shared norms may lower transaction costs and facilitate cooperation and self-insurance (e.g. Isham 2002). But norms may also discourage innovation. Norms of good citizenship or orderliness that promote conservatism and conformity can reduce creative thinking and reaching for out-of-the-box solutions (e.g. Dakhli and De Clercq 2004; Kaasa 2009). Moreover, in-group norms of specific groups that conflict with the interests of wider society could be detrimental to development (Knack and Keefer 1997; Bowles and Gintis 2001). The net impact on innovation, therefore, is ambiguous.

Perspectives on the link between social capital and innovation are evolving. The mainstream view on innovation is shifting from innovation as a "mere technical device" towards a "novel working whole" (Leeuwis and Ban 2004). The latter idea emphasizes the importance of the human practices involved as well as the context within which innovation takes place. The evolution of the concept of innovation is summarized as a progressive shift from a "linear and exogenous" conception of innovation to a "systemic and endogenous" approach, defining innovation as a "learning process." (Brunori et al. 2008 cited in Knickel et al. 2009). In this study we will analyse the role of social capital on the adoption of agricultural innovations for a large sample of African smallholders.

Unfortunately, we lack the necessary data to study the innovation process in detail. Instead, we will study the role of social capital in the adoption of agricultural technologies and techniques that have at some stage emerged from the end of the technology pipeline. That is, we analyse whether various forms of social capital are correlated with the adoption of a very specific type of knowledge (knowledge embodied in varieties, inputs and production techniques). The use of this knowledge is confounded by many other factors, such as effectiveness of input markets and other supply mechanisms, and price incentives via output markets. Other forms of innovation—i.e., the product of interactive, participatory and embedded processes—are perhaps not captured by our innovation data, implying we may

underestimate the full effect of social capital on innovation. This is a caveat to the analysis that follows.

3.3 Data and empirical strategy

To analyse the relation between social capital and innovation we use a novel data set, collected between mid-2008 and 2009 in seven African countries as part of the Sub Saharan African Challenge Program (FARA 2008). The sample area was designed to capture the diversity of Sub Saharan Africa and consists of three regions; (*i*) the central border region between Nigeria and Niger; (*ii*) the border region between Rwanda, Uganda and DRC; and (*iii*) various sites in Zimbabwe, Mozambique and Malawi. However, the data collected in Zimbabwe, during a period of political and economic turmoil, were so scanty (less than 100 complete responses) that we will not include them in this study. To obtain a representative sample for these regions, data collection was based on two-stage sampling. First, stratified sampling to obtain a representative collection of villages and, second, random selection of ten households per village. These data were collected as part of a large randomized experiment. After collection of the data, a random sub-sample of villages was part of an (on-going) experiment aiming to promote participatory learning and bottom-up innovation. The current set of cross-section data essentially is the baseline against which the impact of the intervention will be measured. This implies that in the future we will be able to analyse innovation as a process, and its interaction with social capital.

The survey consisted of two components: a household survey and a village survey (focus-group style). Our social capital variables are based on data from both types of surveys. However, the village survey was often-times incompletely administered, and upon matching the available household and village data our total sample includes 2518 households. This sample adequately covers seven countries (that is, the eight countries minus Zimbabwe). When testing for non-random sample reduction, we obtain mixed evidence. Some variables indicate that it is especially well-off households and villages that have dropped out of the sample, other variables suggest the opposite.[1]

[1] First we check whether the reduction of our sample resulted in a bias towards specific households. We regress a dummy variable (1 if included in the reduced sample) on covariates, and find that age (–), education (–), experience (+), and assets (+) enter significantly. However the coefficients are very small. Moreover, they suggest a "bias" towards factors traditionally favouring innovation (assets and experience)

We now discuss our data in more detail, and first introduce our main dependent variable. We construct an agricultural innovation index based on a variety of available innovations in the domains of land management, post-harvest management and production enhancing innovations such as improved crop varieties. These innovations are listed in Appendix 3.1. They represent the majority of potential technological innovations a small farm-household in SSA can adopt to enhance the production process. This includes various methods to improve the management of soil (fertility), water resources, crops and post-harvest losses. As is evident from the list, the great majority of these innovations are typically "end of the pipeline" products, and do not capture the innovation process as such. Instead, we focus on the link between social capital and the adoption of innovations.

The index sums the adoption of agricultural innovations, and ranges from 0 (i.e. the household has not adopted a single type of innovation) to 20 (implying the household has adopted all 20 types of innovations included in the survey). Ideally, we would construct an index based on those innovations that are applicable in a certain agro-ecological context (i.e. bench terraces are not a viable innovation in swampy areas or on the plains). Unfortunately such data are not available. As an alternative, however, we will construct an index that includes only universally applicable innovations – innovations we expect to be applicable across all agro-ecological contexts. Moreover, country fixed effects should capture some of the agro-ecological context, allowing us to zoom in on differences between villages within a country. Summary statistics for both innovation indices are provided in Panel A in Table 1.

as well as impeding it (negative sign for education). The same holds for the village covariates. Access to schools (+), health care (–), radio (–) and wells (+) enter significantly, again providing a mixed picture. We have also tested if social capital data at village level was missing randomly. Farmers with a higher age (+) and education level (+), and smaller household size and asset index (–) or experience (–) seem to have more missing social capital data. We also observe that missing values increase with radio access and mobile phone access but decrease with access to schools and access to wells. Overall, this mixed evidence does not suggest a particularly strong bias towards a specific type of household or community.

Table 1: Summary statistics innovation and social capital (n=2518)

		Mean	Sd	Min	Max
Panel A: Innovation					
Innovation Index		8.07	4.36	0	20
Essential Innovation Index		3.07	1.78	0	7
Panel B: Social Capital					
Section I					
SC_ I1.1	Village came together for a social function	2.24	1.36	0	4
SC_ I1.2	Village came together to carry out community project	1.67	1.24	0	4
SC_ I1.3	Made financial contributions to help a village member	0.88	1.02	0	4
SC_ I1.4	Came together for a village meeting	1.43	0.96	0	4
SC_ I1.5	Made a field trip to agricultural R&D activity	0.46	0.67	0	4
SC_ I1.6	Gone to another village to see R&D project	0.43	0.62	0	4
SC_ I1.7	People from another village came to see R&D project	0.37	0.58	0	4
SC_ I1.8	Training by an outside organization or field extension staff	0.80	0.85	0	4
SC_ I1.9	Been visited by researchers, staff from NGOs or extension	0.75	0.76	0	4
Section II					
SC_ I2.1	Participation in community activities	2.60	1.00	0	4
SC_ I2.2	Extent of trust among people	2.48	0.93	0	4
SC_ I2.3	Cooperation among people	2.64	0.91	0	4
SC_ I2.4	Extent of giving or exchanging gifts	2.21	1.09	0	4
SC_ I2.5	Extent of financial contribution for community activities	2.20	1.14	0	4
SC_ I2.6	Extent of financial contribution to group activities	2.12	1.16	0	4
SC_ I2.7	Spirit of helping others especially the poor	1.96	1.31	0	4
SC_ I2.8	Extent of settling conflicts or disputes among people	2.78	0.97	0	4
SC_ I2.9	Extent of abiding by the norms and byelaws	2.49	1.16	0	4
SC_ I2.10	Women confidence to speak in public	2.30	1.12	0	4
SC_ I2.11	Men's respect and consideration of women	2.71	0.99	0	4
Section III (mean village values)					
SC_ I3.1	Participation in community development projects	0.76	0.27	0	1
SC_ I3.2	Financial contribution for community activities or actions	0.71	0.31	0	1
SC_ I3.3	Involvement in settling conflicts or disputes among people	0.67	0.27	0	1
SC_ I3.4	Visiting other farmers within community to learn about agric.	0.54	0.30	0	1
SC_ I3.5	Visiting other farmers outside community to learn about agric.	0.38	0.31	0	1
SC_ I3.6	Visiting a research station to learn about agriculture	0.15	0.22	0	1
SC_ I3.7	Visiting an extension office to learn about agriculture	0.19	0.24	0	1

The survey contains three sets of social capital questions (taken from both the household surveys and the village surveys). These questions are summarized in Panel B in Table 1. The first set captures the frequency of certain events. Most indicators are related to structural capital. The data was categorized from 0 to 4, where a score of 0 refers to "never happens" and a score of 4 refers to "happens more than 5 times a month, on average". The second set of

indicators describes aspects of social life in the village. These indicators are also measured on a 0-4 scale where a score of 0 now refers to "never happens" and a score of 4 refers to excellent (or: "happens very often"). Many of these indicators capture cognitive social capital indicators, and are related to norms of cooperation. We expect none of these indicators to be directly related to agriculture — they are of a more general nature. Both sets are based on village focus group discussions. The third set of social capital indicators represents the village average of household's involvement in some of the events and aspects covered in the village survey. These indicators are converted to a continuous 0-1 scale, indicating the share of the households in the village involved.

Our long list of social capital indicators, some of which are obviously strongly correlated, enables us to capture different dimensions of social capital. Following the discussion in section 2.2, we distinguish between structural social capital and cognitive social capital (trust and norms). In addition, and building on a literature that dates back to Putnam (2000), we further sub-divide structural social capital into two sub-classes and distinguish between bonding and bridging social capital. Bonding social capital refers to trust and norms within a well-defined (horizontal) social group, in our case fellow farmers (typically in the same village, but possibly kin members living elsewhere). Bridging social capital, in contrast, refers to linkages across groups, and for example captures whether individuals can hook up with wider networks. Figure 1 summarizes the classification of social capital dimensions that ensues, and how they are matched to the various indicators in Table 1. The resulting categorization, summarized in Table 2, represents the average of the social capital indicators within each category (where village indicators are first normalized on a 0-1 scale).

As another approach to reduce the multidimensionality of our social capital variables we have done a principal factor analysis using a varimax rotation. The Kaiser criteria suggest retaining 4 factors, and the resulting clustering of indicators is partly consistent with the theoretically-informed approach summarized in Table 2. Alternative rotation methods and model specifications result in similar categorizations. In what follows we use the theoretically-informed social capital proxies as the benchmark variables, and use the proxies based on factor analysis in a robustness analysis (section 3.4.3).

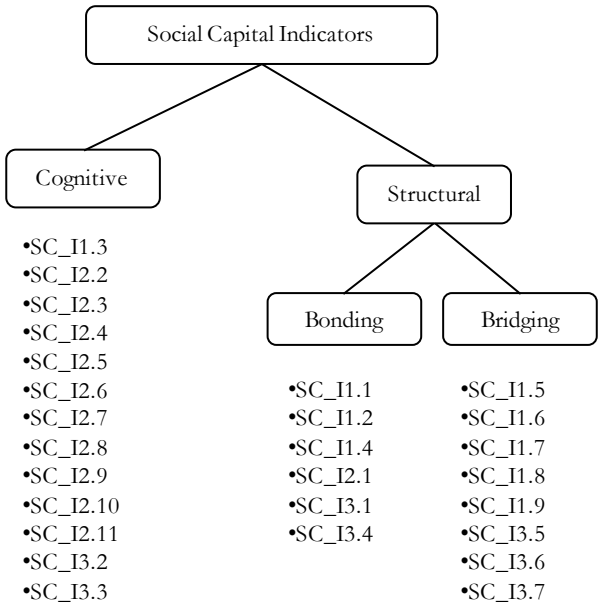

Figure 1: Classification social capital

Table 2: Measures of social capital (n=2518)

		Mean	Sd	Min	Max
SC1	Total Index of Social Capital	0.45	0.12	0.05	0.84
SC2a	Index Cognitive Social Capital	0.58	0.15	0.03	0.95
SC2b	Index Structural Social Capital	0.34	0.12	0.04	0.78
SC3a	Index Cognitive Social Capital	0.58	0.15	0.03	0.95
SC3b	Index Structural Bonding Social Capital	0.55	0.15	0.08	0.96
SC3c	Index Structural Bridging Social Capital	0.18	0.12	0.00	0.64

One concern with these categorizations is that cognitive and structural social capital are not necessarily separate dimensions. Instead, they may reinforce each other non-trivially—norms and relationships are interdependent (Snijders et al. 2007). As a first attempt to probe into this issue we have estimated models that include interaction terms (i.e. the product of our measures of cognitive and structural social capital). However, we found this did not change our main results (see below).

Another concern is that our data places restrictions on what we can do to gauge structural components of social capital. Specifically, we have access to a measure of how

individuals are connected to others, but of course such network properties are relational ("joining social units") and one's network cannot be independent of those of others in the community (Wasserman and Pattison 1996; Bramoullé et al. 2009). To fully capture networks requires the use of census data (Marsden 1990). These notions have given rise to a rapidly growing literature on statistical social network modelling (see Robins et al. 2007 for a recent review). Forced by data constraints, however, we adopt an academic shortcut, and conceptualise networks (structural social capital) as the average connectivity in groups at the village level. Arguably this measure is exogenous to individual innovation measures.

Next, we introduce our control variables. These include household and village characteristics (Table 3). Household variables are age and education of the household head, household size, farming experience, and land (as well as other assets) owned by the household. This list of covariates was motivated by the existing innovation literature (e.g. Isham 2002, Bandiera and Rasul 2006). Village variables capture the availability of public services (school, health care, infrastructure) and means of communication. Finally, we include a set of country dummies in our pooled models.

Table 3: Summary statistics of household and village control variables (n=2518)

	Mean	Sd	Min	Max
Panel A: Household control variables				
Age Head Household	46.31	14.74	18	105
Education Head Household	3.22	2.27	0	22
Size Household	9.10	8.72	1	150
Farm Experience Household	24.56	15.82	0	300
Land owned by Household	6.94	35.06	0	1600
Total Number of Surveyed Assets	3.78	2.59	1	15
Panel B: Village control variables				
School	0.69	0.45	0	1
Health Post	0.37	0.47	0	1
Radio Connection	0.72	0.43	0	1
Mobile Phone Connection	0.85	0.35	0	1
Water Bodies	0.71	0.44	0	1
Boreholls and Wells	0.67	0.45	0	1

To empirically test the ideas discussed in section 3.2 we first estimate several pooled country models (models 1-3). In model 1 we estimate agricultural innovation (I) for household *i* as a

function of the average level of social capital ($SC1$) in village *j*. To control for potential country effects we add a set of country dummies (Z) in model 1b.

$$I_i = f_{1a}(SC1_j) \quad (1a)$$

$$I_i = f_{1b}(SC1_j, Z) \quad (1b)$$

In models 2a-2b we unbundle our social capital indicator in accordance with the classification in Table 2:

$$I_i = f_{2a}(SC2a_j, SC2b_j, Z) \quad (2a)$$

$$I_i = f_{2b}(SC3a_j, SC3b_j, SC3c_j, Z) \quad (2b)$$

In model 3 we add the set of household control variables (X) for household *i* and (Y) for village *j* as defined in Table 3:

$$I_i = f_3(SC3a_j, SC3b_j, SC3c_j, Z, X_i, Y_j) \quad (3)$$

As a final step we investigate whether social capital influences innovation differently across Sub Saharan Africa, and test model 3 for each country separately (referred to as model 4). All models are estimated using Ordinary Least Squares (OLS) with errors defined at the household level[2].

3.4 Results

3.4.1 Pooled Model

Before presenting the regression results we will have a closer look at the data patterns. Farmers in our sample appear to have higher endowments of bonding social capital than of bridging social capital. Table 4 suggests that, on average, higher levels of social capital are associated with higher levels of agricultural innovation (even if there are exceptions). On average, when comparing farmers with 0 innovations with farmers with 20 innovations, the aggregate social capital index goes up with some 0.10 points. This is considerable, given that the minimum aggregate score is only 0.134.

Table 4: Average values social capital by innovation size

[2] We cannot include village-level fixed effects as our social capital variables are also measured at the village level. However, our results are qualitatively robust to estimating a random effects model with village dummies (details available on request).

		Number of innovations					
		0	**1-4**	**5-8**	**9-12**	**13-16**	**17-20**
		(n=88)	(n=529)	(n=687)	(n=784)	(n=382)	(n=48)
SC1	Total Index	0.394	0.396	0.456	0.472	0.498	0.502
SC2	a: Index Cognitive	0.507	0.519	0.588	0.598	0.621	0.606
	b: Index Structural	0.288	0.282	0.332	0.355	0.385	0.406
	a: Index Cognitive	0.507	0.519	0.588	0.598	0.621	0.606
SC3	b: Index Structural Bonding	0.479	0.480	0.551	0.573	0.599	0.613
	c: Index Structural Bridging	0.145	0.134	0.168	0.191	0.224	0.250

We now explore the relation between social capital and innovation with aid of regression analysis. Table 5 presents results of our pooled models (models 1-3 above). Model 1a indicates that, overall, social capital is strongly and positively correlated with the adoption of innovations in Africa. When we add country dummies, model (1b), the coefficient of social capital falls from 10.47 to 3.12, but is still significant at the 1% level. All country dummies enter significant at the 1% level as well (details not shown). In the remaining pooled models we include country dummies.

Because different dimensions of social capital may have different impacts on innovation, we next unbundle our social capital indicator and distinguish between cognitive and structural social capital. According to model (2a), these types of social capital have opposite effects. Specifically, while structural social capital is associated with more adoption of innovations, the reverse is true for cognitive social capital[3].

[3] Following up on the suggestion of one anonymous referee to look at the interaction between norms and relations, we have also estimated this model including a variable capturing the interaction between cognitive and structural social capital. This interaction term did not enter significantly in the pooled model and six of the seven country models (Uganda excluded), suggesting that interdependence of norms and relations is not a great problem for our data.

Table 5: Regression results model 1-3 (n=2518)

Innovation index	**(1a)**	**(1b)**	**(2a)**	**(2b)**	**(3)**
SC1_Total	10.474***	3.122***			
	(0.691)	(0.706)			
SC2a_Cognitive			-2.273***		
			(0.633)		
SC2b_Structural			6.174***		
			(0.741)		
SC3a_CogBon				-1.488**	-1.478**
				(0.643)	(0.626)
SC3b_StrBond				-0.737	-0.954
				(0.653)	(0.637)
SC3c_StrBrid				7.541***	7.071***
				(0.798)	(0.786)
Hh-age head					-0.006
					(0.007)
Hh-education head					0.081**
					(0.032)
Hh-size					0.024***
					(0.009)
Hh-experience					0.017***
					(0.006)
Hh-land owned					0.003
					(0.002)
Hh-assets index					0.331***
					(0.036)
Vil-schools					-0.502***
					(0.176)
Vil-health					0.059
					(0.181)
Vil-radio					0.038
					(0.202)
Vil-mob					1.045***
					(0.199)
Vil-water bodies					-0.379**
					(0.166)
Vil-wells					-0.193
					(0.191)
country dummies	no	yes	yes	yes	yes
constant	3.316***	1.566***	2.228***	2.858***	1.383***
	(0.324)	(0.316)	(0.327)	(0.342)	(0.456)
adj. R-sq	0.083	0.380	0.392	0.400	0.439

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

The finding that participation in wider networks correlates with more innovation could be due to enhanced information or better access to resources. In contrast, norms of trust may result in inward-looking modes of behaviour, emphasizing conformity and reducing willingness to innovate. It could also be that building and maintaining cognitive social capital is especially time-consuming, displacing time and resources otherwise allocated to exploring opportunities for innovation. Another reason could be that the impact of social capital depends not only on the different dimensions, but also on the relative size of the different dimensions. Knack and Keefer (1997) for example argue that high levels of bonding capital, without bridging capital can result in limiting the flow of inputs or information beyond local networks, one of the main mechanisms through which innovation is expected to influence innovation.

The results are made more precise in models (2b) and (3). These models both further unravel social capital into three distinct sub-types: cognitive -, structural-bonding -, and structural-bridging social capital. Strong intra-community trust and norms are associated with fewer innovations, and participating in vertical networks with "outsiders" is associated with enhanced adoption of innovations. Participation in horizontal (intra community) networks does not appear to be significantly correlated with innovation, regardless of whether we control for a list of covariates (model 3), or not (model 2b).

Note that the coefficients of interest do not change much when we add the controls. The household controls themselves are related to innovation in way that conforms to expectations. Adoption of agricultural innovations is positively related to level of education, experience of the household in farming, and household wealth (proxied by the number of assets owned). At the village level, three control variables are significant. The availability of a mobile phone network has the expected positive sign. The coefficients for the other two variables (presence of a school and water bodies–streams, ponds and rivers) are negative.

3.4.2 Country Models

The African countries in our pooled sample differ across many dimensions — agro-ecological, economic, social and institutional conditions. Table 6 summarizes social capital and agricultural innovation for the countries in our sample, confirming that the countries are different in these domains as well. Because it is not evident that this heterogeneity is fully captured by the country dummies, we also estimate the main innovation model for each country separately. Interestingly, casual inspection suggests that the overall tendencies discussed above vary considerably from country to country—the pooled model masks considerable heterogeneity at

the country-level. For example, while DRC scores for most of the social capital proxies are rather average, its innovation score is much lower than the score of the other countries. Upon comparing rows and columns, however, it appears as if within-country variation of social capital scores is greater than cross-country variation in terms of scores for specific forms of social capital. In particular, the bonding social capital scores appear much higher than the bridging scores, confirming anecdotal evidence about strong micro-institutions (based on kinship or otherwise) and weak integration of rural communities into greater networks.

Table 6: Social capital by country

		Country						
		DRC	**MW**	**MZ**	**NE**	**NG**	**RW**	**UG**
		(n=441)	(n=318)	(n=277)	(n=356)	(n=533)	(n=186)	(n=407)
Innovation index		2.763	10.097	6.418	9.339	9.757	10.608	8.854
SC1	Total Index	0.383	0.482	0.377	0.442	0.576	0.453	0.410
SC2	a: Index Cognitive	0.503	0.630	0.475	0.563	0.716	0.583	0.527
	b: Index Structural	0.272	0.344	0.287	0.329	0.445	0.332	0.301
SC3	a: Index Cognitive	0.503	0.630	0.475	0.563	0.716	0.583	0.527
	b: Index Structural Bonding	0.459	0.566	0.470	0.542	0.641	0.649	0.527
	c: Index Structural Bridging	0.132	0.177	0.150	0.169	0.299	0.095	0.132

Across the board, the country-data appear consistent with the results of the pooled data discussed above — innovation levels appear to "match" relevant social capital levels. However, there are serious exceptions. For example, Nigeria has the highest level of structural and bridging social capital, yet it only ranks third in terms of the innovation index. In contrast, Rwanda's innovation score ranks first, but it also scores at the bottom in terms of bridging social capital. In Table 7 we aim to analyse the relationship between unbundled social capital and innovation for each country separately, controlling for our complete list of covariates (note that many entered significantly in the pooled model, improving its explanatory power).

The country-specific results tend to support those of the pooled model. As before, cognitive bonding social capital is negatively associated with adoption of innovations for three out of seven countries at a 1% or 5% confidence level (Mozambique, Nigeria, Niger). Similarly, structural-bridging social capital is positively associated with innovation for Mozambique, Niger, Nigeria and Uganda**Error! Bookmark not defined.**. This is expected, as it captures agriculture-related links to the broader world through extension agents, NGOs and other institutions,

increasing access to knowledge and resources. But there are also new results that challenge the robustness or the general validity of the findings of the pooled data.

Table 7: Regression results model 4

Innovation index	(4-DRC)	(4-MW)	(4-MZ)	(4-NE)	(4-NG)	(4-RW)	(4-UG)
SC3a_CogBon	1.952*	-1.863	-4.206*	-5.402**	-8.929***	-10.694	1.624
	(1.125)	(1.536)	(2.285)	(2.390)	(1.739)	(7.397)	(1.641)
SC3b_StrBond	-2.015	2.421	4.649**	0.091	3.009*	-5.471**	-7.981***
	(1.329)	(2.270)	(2.275)	(1.460)	(1.644)	(2.639)	(1.827)
SC3c_StrBrid	1.391	1.496	12.191***	15.277***	4.085***	-3.325	10.279***
	(1.693)	(2.756)	(3.410)	(2.246)	(1.510)	(7.856)	(2.514)
Hh-age head	0.007	-0.007	0.023	-0.047***	-0.007	-0.005	-0.014
	(0.015)	(0.017)	(0.018)	(0.017)	(0.018)	(0.034)	(0.018)
Hh-education head	-0.046	0.237**	0.448***	-0.033	0.005	0.680***	0.156*
	(0.053)	(0.106)	(0.154)	(0.110)	(0.059)	(0.143)	(0.090)
Hh-size	0.025	-0.001	0.122**	-0.001	0.018*	0.178*	0.061
	(0.037)	(0.043)	(0.061)	(0.031)	(0.010)	(0.101)	(0.067)
Hh-experience	0.002	-0.001	-0.009	0.060***	0.027	0.048	0.027
	(0.015)	(0.019)	(0.012)	(0.017)	(0.017)	(0.030)	(0.018)
Hh-land owned	0.089***	0.002	0.093*	0.021	0.003	-0.017	-0.013
	(0.016)	(0.038)	(0.048)	(0.023)	(0.002)	(0.039)	(0.027)
Hh-assets index	-0.006	0.408***	0.191	0.295***	0.397***	0.561***	0.034
	(0.091)	(0.117)	(0.132)	(0.080)	(0.055)	(0.189)	(0.138)
Vil-schools	-0.200	-0.581	-2.616***	-3.306***	-0.902	-0.592	0.436
	(0.422)	(0.377)	(0.973)	(0.568)	(0.610)	(0.865)	(0.400)
Vil-health	-0.345	0.730	-0.850	0.450	-0.004	-0.522	0.190
	(0.409)	(1.347)	(0.559)	(0.348)	(0.432)	(1.370)	(0.665)
Vil-radio	-0.800**	-0.612	-1.381	-0.262	-0.450	-3.050	1.156***
	(0.322)	(0.554)	(1.163)	(0.935)	(0.675)	(2.431)	(0.414)
Vil-mob	-0.028	0.579	-0.322	1.838**	1.491**	-0.753	2.321***
	(0.376)	(1.688)	(0.563)	(0.722)	(0.615)	(0.894)	(0.497)
Vil-water bodies	0.339	-0.930*	-0.288	-1.164***	1.560***	1.394	-1.217**
	(0.367)	(0.544)	(0.871)	(0.326)	(0.486)	(0.891)	(0.481)
Vil-wells	0.442	-0.890	0.602	0.000	0.664	-1.325	0.062
	(0.425)	(0.912)	(0.616)	(0.000)	(0.491)	(1.213)	(0.456)
constant	2.248***	9.897***	4.453*	10.829***	7.296***	15.913***	8.119***
	(0.753)	(3.263)	(2.284)	(1.666)	(1.537)	(5.722)	(1.415)
N	441	318	277	356	533	186	407
adj. R-sq	0.085	0.057	0.251	0.254	0.273	0.231	0.153

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

First, while structural-bonding social capital did not enter significantly in the pooled model, we now observe it is significantly correlated with innovation in no less than four countries. However, positive and negative correlations are equally prevalent, explaining why we did not detect a significant average effect. Positive associations eventuate for Mozambique and Nigeria, and negative ones for neighbouring Uganda and Rwanda. This is especially interesting in light of the observation that these countries have comparable levels of innovation and structural bonding social capital. Additional regression analysis (not shown) suggests there is no explanation based on the relative size of the innovation index, the interaction among social capital dimensions or other characteristics at the country level (i.e. average land/labour ratios, openness of economy or being a post conflict country) or household level (i.e. assets or education). When estimating model 2b we see that for Mozambique and Nigeria the association with cognitive bonding social capital is much stronger than that of structural bonding social capital, because the signs are negative and significant. This corresponds to the results for Rwanda. For Uganda the coefficient is not significant. This implies that when we don't combine the two different categorization of social capital, results are consistent across the board.

Second, DRC is an exception to the "rule" that cognitive-bonding social capital is negatively correlated with innovations. DRC had the lowest score in terms of innovation, and peace has not gained a firm foothold in the study region. On-going conflict, and the inability to develop formal institutions that foster development, might explain this atypical outcome. As discussed in section 3.2, we expect cognitive social capital to have an ambiguous effect on innovation — shared norms may facilitate cooperation and self-insurance, but also promote conformity. Our regression results suggest a more precise hypothesis, namely that the former effect dominates in a situation of turmoil and conflict, and that the latter effect dominates under more predictable circumstances. This hypothesis is supported by the extremely low Worldwide Governance Indicators for DRC (the average index for DRC is 4.92, whereas the other countries in our sample score between 18.04 and 47.8). However care needs to be taken when interpreting these results because the coefficient is only significant at the 10% level. Future research should explore this issue in a more systematic fashion, and analyse when and how context matters.

3.4.3 Robustness

We now explore the robustness of our results, and discuss four alternative models. Regression results are presented in Table 8.[4]

Until now we used ordinary least square (OLS) to estimate our models. However, because our dependent variable consist of count data ranging between 0 and 20, a Poisson model may be more appropriate. Column 1 confirms that cognitive bonding social capital is negatively associated with the level of innovation. The size of the coefficient is comparable to that of model 3 (for mean values of the exogenous variables). Column 1 also reports that structural bridging social capital is positively associated with innovation, as before. The main difference with model 3 is that the coefficient for structural bonding social capital, which was insignificant, now enters significantly and with a negative sign. However, this coefficient was border-line significant in our OLS model as well, so overall the findings are fairly comparable.

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In the next column of Table 8 we replace our broad innovation index by an index that captures a subset of more universal innovations – agricultural innovations that are relevant for farmers across different contexts (see Appendix 3.1). The positive association between structural bridging social capital and innovation is again confirmed. However, the coefficient for cognitive bonding social capital becomes smaller and turns insignificant.

[4] Unless specified otherwise, country models (not provided here) illustrate qualitatively similar results for the robustness analysis.

Table 8: Robustness analysis (n=2518)

Innovation index	(1) poisson	(2) essential inn.	(3) village level	(4) factors
SC3a_CogBon	-0.162**	-0.234	-1.999***	
	(0.070)	(0.295)	(0.745)	
SC3b_StrBond	-0.120*	-0.089	0.957	
	(0.069)	(0.300)	(0.609)	
SC3c_StrBrid	0.845***	2.109***	4.431***	
	(0.084)	(0.370)	(0.819)	
Factor 1				-0.177**
				(0.081)
Factor 2				0.542***
				(0.076)
Factor 3				-0.102
				(0.090)
Factor 4				0.706***
				(0.094)
Hh-controls	yes	yes	yes	yes
Vil-controls	yes	yes	yes	yes
Country dummies	yes	yes	yes	yes
constant	0.812***	1.145***	0.331	1.106***
	(0.0568)	(0.215)	(0.601)	(0.377)
adj. R-sq	0.196	0.251	0.498	0.443

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

To test the quality of our social capital indicators, which until now are based on a combination of village and household data, we have also constructed social capital variables based on the focus group (i.e. village level) data only (see section I and II, Panel B Table 1). While the magnitude of the coefficients varies, the concluding findings are unaffected.

Finally, we use factor analysis to further probe the robustness of our findings (results of the factor analysis are given in Appendix 3.2). The first factor captures mainly indicators identified as cognitive social capital. The negative and significant coefficient in column 4 is therefore as expected. The second factor covers a mix of structural social capital indicators, resulting in a positive and significant coefficient. The third factor is a mix of different types of social capital, even though the loading on bonding indicators is higher than the loading on bridging indicators. The coefficient is negative, but not significant. Our final factor again enters

positively and significantly. It captures several indicators, scoring especially high on structural bridging social capital.

The factor analysis provides some support for the way we have grouped indicators together (but recall that the analysis is based on proxies of true networks only). In particular, our theoretical grouping of variables into dimensions covering cognitive and structural bridging social capital is rather consistent with the factor analysis. Hence, these indicators are correlated and proxy for the same type of social capital. However, the results with respect to structural bonding social capital are less clear-cut, and various relevant indicators are spread across multiple factors. This suggests the empirical categorization in sub-classes of social capital is less clean than predicted by theory. However, with the data at our disposal it is impossible to examine whether this is due to the way we have measured (structural) social capital, or due to possible interdependence of structural and cognitive social capital.

3.5 Discussion and conclusion

The important role of social capital in processes of growth and development is widely acknowledged. A rapidly growing literature identifies various channels through which social capital "matters". In this paper we investigate one such channel, and explore whether social capital is associated with the adoption of agricultural innovations. We unbundle social capital, and distinguish between three dimensions: cognitive social capital, and two forms of structural social capital (bonding and bridging). Using a novel data set covering multiple African countries we illustrate that these dimensions are associated with innovation in a variety of ways. We also illustrate that results are generally consistent across the different countries, even though there are some noteworthy exceptions.

We obtain a large and significant association between an aggregate measure of social capital and the adoption of agricultural innovations by farmers. Further analysis reveals this association stems mainly from so-called structural bridging social capital—the participation in networks that extend beyond the local village. This form of social capital captures agricultural-related links creating access to knowledge and resources; hence this result is not surprising.

We find a negative association between cognitive social capital, capturing intra-community norms of cooperation and trust, and our innovation index. This result emerges both in the pooled data and some of the country models. This finding could represent "a dark side" of social capital. High levels of cognitive social capital might result in inward-looking

modes of behaviour, or displace time and resources away from agricultural innovation. However, this result does not imply that cognitive social capital is unimportant – it could serve other functions for community members (including insurance to idiosyncratic shocks, etc.). It only suggests that communities may pay a price for such functions in the form of attenuated incentives for innovation.

We speculate these results have implications for policy makers. First, since both structural and cognitive social capital matters for the adoption of innovations, it may provide a natural leverage point for policy makers to promote agricultural development. Work by, for example, Fearon et al. (2009) suggests that social capital levels in villages respond to outside interventions, such as specific aid projects. Targeted interventions and projects could perhaps be exploited to foster innovation and development. Second, and related, it appears as if cognitive bonding social capital is a factor that impedes adoption of innovations. Insofar as education and safety network programs contribute to relaxing the push for conformity, enhanced adoption of agricultural innovation may be a by-product.

There is ample scope for follow-up research. First, our country models suggest considerable cross-country heterogeneity. The way social capital interacts with other variables could be context-specific, and deserves closer scrutiny. For example, we find that cognitive social capital is positively associated with innovation in the DRC. We speculate this may be due to turmoil created by on-going conflict – a context in which shared norms and trust are perhaps especially relevant. Second, it would be interesting to conduct a similar analysis using an alternative set of innovation indicators. The current analysis is based on innovations that have emerged from the "technology pipeline," but arguably more significant effects materialise for a broader set of indicators encompassing innovations that are the product of local interactive and embedded innovation processes. Third, future research should attempt to unravel the chain of causation, and extend beyond establishing correlations. This arguably reflects constructing panel datasets.

3.6 Appendix

Appendix 3.1: Innovation indicators (n=2518)

Innovation Indicators	Mean	Sd	Innovation Indicators	Mean	Sd
Soil and Water Management Innovation			**Post Harvest Innovation**		
Mulching*	0.362	0.481	Drying	0.598	0.490
Trenches and Terraces	0.261	0.439	Threshing/Shelling Equipmen	0.329	0.470
Water Harvesting	0.163	0.369	Improved Storage Facilities	0.251	0.434
Irrigation	0.303	0.459	Pest Control	0.421	0.494
Conservation Farming	0.215	0.411	Grading	0.374	0.484
Other	0.259	0.438	Other	0.011	0.105
Soil and Fertility Management Innovation			**Other Product Enhancing Innovation**		
Animal Manure*	0.647	0.478	Improved Varieties	0.375	0.484
Cover Crops	0.174	0.379	Livestock Breeds	0.021	0.142
Crop Rotation*	0.483	0.500	Livestock Drugs & Feed	0.185	0.389
Intercropping*	0.227	0.419	Other	0.053	0.225
Rhizobia Inoculation	0.008	0.089	**Crop Management Innovation**		
Chemical Fertilizer	0.095	0.293	Row Planting*	0.583	0.493
Other	0.464	0.499	Plant Spacing*	0.476	0.500
			Organic Pesticides	0.145	0.353
			Inorganic Pesticides	0.089	0.285
			Other	0.412	0.492

Appendix 3.2: Factor analysis (n=2518)

Dimension		Factor1	Factor2	Factor3	Factor4	Uniqueness
I1.3	Cognitive		0.376			0.785
I2.2	Cognitive	0.525				0.670
I2.3	Cognitive	0.560				0.624
I2.4	Cognitive	0.573				0.633
I2.5	Cognitive	0.647				0.533
I2.6	Cognitive	0.633				0.536
I2.7	Cognitive	0.485			0.359	0.601
I2.8	Cognitive	0.439				0.791
I2.9	Cognitive	0.416				0.747
I2.10	Cognitive	0.258				0.915
I2.11	Cognitive	0.470				0.747
I3.2	Cognitive			0.875		0.194
I3.3	Cognitive			0.754	0.265	0.352
I2.1	Stru-Bond	0.458				0.708
I1.1	Stru-Bond		0.415			0.722
I1.2	Stru-Bond					0.927
I1.4	Stru-Bond		0.441			0.750
I3.1	Stru-Bond			0.893		0.177
I3.4	Stru-Bond			0.507	0.555	0.427
I1.5	Stru-Brid		0.630			0.600
I1.6	Stru-Brid		0.812			0.335
I1.7	Stru-Brid		0.652			0.559
I1.8	Stru-Brid		0.624			0.556
I1.9	Stru-Brid		0.643			0.561
I3.5	Stru-Brid			0.433	0.670	0.352
I3.6	Stru-Brid				0.767	0.370
I3.7	Stru-Brid				0.766	0.358

Note: blanks represent loading<.25

Chapter 4 The impact of agricultural extension services on social capital: an application to the Sub-Saharan African Challenge Program in Lake Kivu region

Abstract: Many participatory projects in rural Africa aim to indirectly enhance development by promoting different dimensions of social capital: cooperation in networks (formal or informal), trust and norms of behaviour that encourage mutually beneficial action. However, it is unclear whether external interventions can actually influence these dimensions of social capital, especially in the short term. To address this question, we used semi-experimental data to investigate the effects of agricultural research and development (ARD) on various indicators of social capital in the border region of Rwanda, Uganda and the DRC. Specifically, we focused on the effects of the Integrated Agricultural Research for Development Approach (IAR4D) and compared it to conventional ARD efforts. We showed that IAR4D has influenced the level of social capital, although not in all dimensions and not consistently for all countries. In the DRC and Uganda, for example, IAR4D strengthened the networks that link villages to the outside world (bridging social capital), but not in other countries. We also found indications that IAR4D resulted in higher levels of intra-village networks (bonding social capital) in Rwanda and improved trust and norms of cooperation (cognitive social capital) in the DRC. Finally, we showed that traditional agricultural extension (ARD) has been less successful than IAR4D.

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4.1 Introduction

Social capital – usually defined in terms of trust, adherence to norms and/or participation in networks – is known to play an important role in development. In recent decades, social capital has been used to explain more and more phenomena. For example, the seminal work by Knack and Keefer (1997) and Zak and Knack (2001) illustrated how social capital, in terms of trust and civic norms, is related to economic growth and investment. At the micro level, social capital is being increasingly used as an explanatory variable for aspects such as household income (Narayan and Pritchett 1999), advanced agricultural innovation (Isham 2002; Bandiera and Rasul 2006), access to credit (Besley et al. 1993) and reduced transaction costs (Fafchamps and Minten 2002).

It is still unclear under which conditions these and other benefits of social capital accrue (e.g. Ahlerup et al. 2009) or whether they are in fact always positively related to development (e.g. Dasgupta 2005). Underlying this discussion is the wide variety of concepts and measures used to capture social capital. Some researchers question whether the concept has been conceptualised and measured appropriately (Sabatini 2005) and even whether it should be used at all (Bowles and Gintis 2001). Woolcock (2010) uses the term "essentially contested concepts" from Gallie (1956) to emphasize that the utility of the concept lies in facilitating constructive discussion on the importance of social relationships, rather than on forging consensus on how it is defined exactly. In any case much development aid increasingly pays attention to the importance of social relations, or building social capital. Many of these projects aim to enhance economic development indirectly by promoting cooperation in networks and by encouraging trust and norms of behaviour that involve mutual beneficial action. Mansuri and Rao (2004) estimated that the World Bank alone increased its lending to "community driven" and "participatory" projects from $325 million in 1996 to $2 billion in 2003; if a broader definition is used, the lending increased from $3 billion to $7 billion.

However, it is far from clear whether external interventions can actually influence social capital, especially in the short term. Many authors argue that social capital is a result of long-term historical processes (Putnam 2000; Bowles and Gintis 2001; Nunn and Wantchekon 2011). On the other hand, some empirical evidence also indicates the potential to influence social capital (e.g. Bebbington and Carroll 2002; Krishna and Uphoff 2002), even in the short term (Fearon et al. 2009; Labonne and Chase 2011). On balance, however, the research on social capital has been more successful at documenting its potential role in development than identifying how, whether and to what extent external interventions can contribute to this

process (Grootaert and Bastelaer 2002). Without such knowledge, the policy implications of the documented effects of social capital remain unclear.

One initiative where social capital has a clear role is in Integrated Agricultural Research for Development (IAR4D). Hawkins et al. define (2008) IAR4D broadly as "a set of individual and organisational behaviours that promote the integration of stakeholder concerns, knowledge, action and learning around a theme of mutual interest". The development of IAR4D by a broad range of actors involved in agricultural research and development stems from the dissatisfaction with the fragmented and reductionist approach of traditional agricultural research and development. Hawkins et al. argue that if development is " … about behaviour and capacity, then IAR4D needs to focus on improving behavioural processes and capacities as outcomes, rather than on (technology or policy) products as outputs". Against this background, the Sub-Saharan African Challenge Programme (SSA CP) was initiated in 2005. The SSA CP has adopted IAR4D as its main philosophy. Innovation Platforms (IP), which can be described as an informal coalition and alliance of conventional agricultural research and development actors, are at the core of the approach.

This programme clearly illustrates the important role social capital can have in development interventions with a participatory and multi-stakeholder character. The objective of our research was to analyse the effects that such a programme can have on various indicators of social capital. We did this by analysing data collected in the context of the SSA CP in the border region of Rwanda, Uganda and the DRC. We also compared the impact of IAR4D to the impact of conventional Agricultural Research and Development (ARD). We separated our indicators according to two dimensions: structural and cognitive, and bonding and bridging social capital.

In Section 4.2 we discuss our theoretical framework, including a more detailed discussion on the concept of social capital, the role of social capital in development interventions, the IAR4D approach and the role of social capital in this approach. In Section 4.3, we summarise our data and describe the model that we used to estimate the impact of IAR4D and ARD on social capital. In Section 4.4 we discuss the outcomes of these models, including several tests of robustness. We discuss our results in Section 4.5 and present our conclusions in Section 4.6.

4.2 Theoretical Framework

4.2.1 Development aid and social capital

Despite the conceptual vagueness of social capital (see section 2.1 and 2.2) and the uncertainty of its benefits (see section 2.4), development aid has invested significantly in efforts to increase it. Many of these efforts are community-driven or participatory projects based on the "community-driven development" approach, an umbrella term for projects and programmes that actively include their beneficiaries in processes such as design, management and evaluation. In a critical review, Mansuri and Rao (2004) showed that little evidence is available on the effectiveness of this approach. It is therefore unclear whether the benefits of social capital that the projects try to promote – reducing information problems, expanding resources available to the poor and strengthening the organisations that represent them – are actually achieved. Some even argue that the rapid expansion of such efforts has resulted in a severe waste of development resources (Yujiro 2009).

More generally, it is still debatable whether external interventions can actually influence social capital, especially in the short term. A large body of literature suggests that social capital is historically derived (e.g. Putnam 2003 cited in Grootaert and Bastelaer 2002), is a result of long-run evolutionary processes (Bowles and Gintis 2001) or is shaped by critical junctures in history, such as the extraction of slaves from Africa (Nunn and Wantchekon 2011). Pargal et al. (2002) argued that social capital, which they equate with community cohesion, might be something that is inherent to people's ability to relate to one another. They showed that "homogeneity of interests and points of view" are paramount in explaining levels of social capital in their sample in Bangladesh. Even though social capital can be channelled to different uses, they suggested it might be hard for policy makers to influence actual levels of social capital (also see Alesina and Ferrara 2005 cited in Fearon et al. 2009). Others have empirically verified that development assistance programmes or projects, specifically those focusing on influencing social capital (or certain facets thereof), were unsuccessful (Gugerty and Kremer 2002). This coincides with the idea that programmes focussing on social capital may not be purposefully designed for economic benefit. Rather, when the need arises, pre-existing social capital is used (Yujiro 2009).

However, this does not mean that social capital cannot be created. An increasing number of studies have indicated that social capital can in fact be influenced by external interventions, even in the short term. For example, Krishna and Uphoff (2002) illustrated that

intra-district differences in social capital are much bigger than the inter-district differences that could be a result of history. More specifically, a number of studies have suggested that social capital can indeed be influenced by external interventions. Uphoff and Wijayaratna (2000) showed how efforts to induce social capital in Indonesia, in terms of collective irrigation management, resulted in long-term successful cooperation. Case study evidence from the rural Andes reported by Bebbington and Carroll (2002) showed that trust, reciprocity and cooperation can be stimulated by sensitive and persistent support. Pronyk et al. (2008) provide statistical evidence in relation to a microfinance program in South Africa that social capital can be generated intentionally. Recent work by Fearon et al. (2009), using a randomised field experiment to analyse the impact on community reconstruction groups in Liberia, supports this Also based on a solid statistical analysis, Labonne and Chase (2011) showed that community driven development projects in Philippines increased various indicators of social capital. Even more interesting, both studies show the impact was achieved within a time frame of about two years.

4.2.2 Integrated Agricultural Research for Development and social capital

To understand the role of social capital in IAR4D, we must take a closer look at how IAR4D is conceptualised in practice. The core of the approach relies on Innovation Platforms (IPs) which, although operating at various administrative levels, are positioned at the local governmental level and are active at the village level. They represent an institution that brings together stakeholders in the agricultural sector, including farm households, local government agencies, scientist, NGOs and traders. To abide with the IAR4D approach, the IPs have to fulfil five criteria (Hawkins et al. 2008). First, they should be characterised by representative, inclusive and diverse partnerships. A second criterion relates to the existence of nonlinear, collective and collaborative interaction among IP actors. Third, research should address key constraints and opportunities in the value chain as agreed upon in the IP. Fourth, the research process should be multidisciplinary and participatory. The fifth criterion states that institutional and human capacity building of IAR4D actors is part of the approach.

This clearly shows that the main aim of IAR4D is not to directly influence certain development outcomes (e.g. agricultural innovation or income), but to create a setting to enable these outcomes. The formation of the IP is therefore the immediate output of the IAR4D approach. The activities that are initiated as a result of the interaction in these IPs are probably the largest source of IAR4Ds potential influence on the level of (structural) social capital. These can take place between households within the same village (i.e. bonding social

capital), but mostly between farm households and other actors involved in agricultural research and development, such as scientists, local government agents and traders (i.e. bridging social capital). Examples of such activities are the formation of farmer groups for the implementation of measures to control soil erosion in Bufundi, Uganda; the organisation of communal sales of cassava in Masisi, DRC; or the introduction of a loan scheme for dairy cattle in Burera, Rwanda. These activities might go hand in hand with changes in trust or norms of cooperation (i.e. cognitive social capital). The IP might also stimulate formal and informal networks, trust and norms of cooperation outside the IP. This increase in different dimensions of social capital can enable the adherence to key constraints and opportunities as agreed upon in the IP (Criterion 3) and allow the research process to be multidisciplinary and participatory (Criterion 4). Together, these impacts on and through social capital are expected to result in improved development outcomes. The latter will be a topic for future research.

Social capital is thus an important component of IAR4D, which aims to increase farmers' participation in the identification and evaluation of innovations and the collective action in the production and marketing of agricultural products. We focus on the effect of the IAR4D approach in its entirety, with the IP as its immediate outcome, rather than on the effect of the exact activities resulting from the IPs which clearly vary by platform. Our study thus investigated whether social capital is indeed influenced by the IAR4D approach and how it relates to the influence of the conventional Agriculture Research and Development initiatives (ARD).

4.3 Data and Methodology

4.3.1 Data set and sampling

To analyse the relationship between IAR4D and social capital, we used data collected in a large-scale experiment to test the impact of the Integrated Agricultural Research for Development (IAR4D) approach. The data collection corresponding to the experimental approach of the program was part of the Sub-Saharan African Challenge Programme (SSA CP). Measurement of social capital was considered important from the start of the project because it is considered one of the pathways through which IAR4D operates and generates impact. The data set consisted of a baseline survey conducted between mid-2008 and mid-2009 and a second survey in mid-2010[5]. The sample area consisted of the border region between

[5] Previous results using this data were reported by e.g. chapter 3 and Nkonya, Oduol et al. (2010).

Rwanda, Uganda and the DRC – referred to as the Lake Kivu (LK) project learning site. Being set up as a large-scale experiment for evaluating the impact of IAR4D, in this section we discuss how we constructed a realistic counterfactual: what would have happened to the level of social capital if the programme had not been implemented?

To obtain a representative sample, data collection was based on various stages (FARA 2009) [6]. First the region was stratified according to the various countries. The LK region was initially chosen because the various countries emerged from conflict at different times in recent decades, resulting in differing national policies, institutions and physical infrastructures (Bekunda et al. 2005 from Farrow et al. 2011). These differences could influence the outcomes of IAR4D. The second stage was a characterisation of target zones in terms of market access; four sites were randomly selected in each country, two with good market access and two with poor market access. Following a structured village characterisation on aspects such as the level of agricultural research and development between 2003 and 2008, villages in each zone were classified into two types: villages with conventional agricultural research and development projects (ARD villages) and villages without ARD (clean villages). ARD projects included those initiatives identifying, promoting and disseminating technologies, mostly related to the production and marketing of farm products. In sites with mostly clean villages, 76 villages were randomly selected for IAR4D intervention. In sites with a mixture of clean and ARD villages, 82 villages were selected as clean counterfactual villages and 84 were selected as "ARD counterfactual" villages. The final stage was based on a random selection of 10 households per village.

[6] See Farrow, Opondo et al. and Thorton, Stroud et al. for a detailed discussion on site selection.

Table 1: Ex-ante comparison treatment and control groups (n=2237)

	IAR4D	Control 1: clean			Control 2: ARD		
	n=676	n=772			n=789		
	Mean	Mean	diff		Mean	diff	
Panel A: household variables							
gender of household head	0.815	0.793	-0.022		0.828	0.013	
age of household head in years	44.803	45.909	1.106		45.592	0.789	
education level of household head	3.294	3.354	0.059		3.402	0.107	
highest level of education attained by hh	4.490	4.597	0.108		4.782	0.292	**
size of the household	6.396	6.510	0.114		6.768	0.372	**
number of males aged 16-58years	1.499	1.443	-0.056		1.574	0.076	
number of females aged 16-58years	1.504	1.558	0.054		1.612	0.108	**
number of years of experience in farming	21.452	22.495	1.043		22.409	0.957	
asset index (agricultral and non-agricultural assets)	1.960	1.848	-0.112	*	1.916	-0.044	
visit to extension agent in past year	0.084	0.082	-0.003		0.084	-0.001	
visit by extension agent in past year	0.044	0.041	-0.003		0.046	0.001	
participation in research demonstration in past year	0.056	0.036	-0.020	*	0.047	-0.009	
membership in farm association	0.241	0.271	0.030		0.243	0.002	
number of rooms (excl. kitchen and bathrooms)	3.692	3.573	-0.120		3.807	0.115	
Panel B: village variables							
schools	0.478	0.468	-0.010		0.435	-0.043	*
health centres	0.111	0.142	0.032	*	0.207	0.096	***
boreholes/wells	0.163	0.168	0.006		0.240	0.077	***
network coverage for radio	0.559	0.396	-0.163	***	0.368	-0.192	***
all weather roads	0.584	0.468	-0.117	***	0.506	-0.079	***
network coverage for mobile phones	0.790	0.702	-0.088	***	0.728	-0.062	***

* p<0.1, ** p<0.05, *** p<0.01 signifcantly different from IAR4D

Compared to the evaluations of many existing development interventions (if any), this sampling strategy is a major improvement. Nevertheless, the data has two limitations considering the measurement of impact. First of all, whereas clean and IAR4D villages were selected from the same pool of villages (those without ARD during the last 2-5 years), the ARD villages were selected from a group of villages that already received ARD. It can be argued that receiving ARD is a result of specific characteristics such as accessibility or informal networks, and that those villages might have performed better or worse to start with. Second, social capital data was not well registered in the baseline survey and is missing for about 50%

of the villages (although it was correctly captured at household level). When analysing the missing data, we did not find a consistent pattern in terms of observable household or village characteristics; of the covariates that are significant in explaining whether social capital data is missing, some are expected to be correlated with higher levels of social capital, whereas others are expected to be correlated with lower levels of social capital[7]. However, the social capital data was missing for specific regions, resulting in a potential bias. Because data collection was part a stratified randomised intervention we therefore rely on the 2010 data for our main analysis. We controlled for the differences in observable baseline conditions listed in Table 1in all our estimations. We also estimate our results separately for IAR4D from that of ARD. Moreover, we used a fixed effect model and a propensity score model to test the robustness of our results (see section 4.3.4 for more details).

4.3.2 Social capital indicators

We used a mix of social capital indicators from the focus-group survey with farmers in the village (Panel A and B in Table 2) and the household survey (Panel C in Table 2). The first part captured the occurrence of certain gatherings at the village level by asking "How often in the last twelve months has the following happened in the village (0 to a maximum)?" The answers were rescaled to a 0 to 4 scale, where a score of 0 means "never happens" and a score of 4 means "happens more than 5 times a month on average". The second set of indicators describes aspects of social life in the village by asking "How would you assess this village on the following aspects?" These indicators were measured on a 0-4 scale, where a score of 0 means "never happens" and a score of 4 means "happens very often". Besides the village data, we also used a set of social capital indicators at the household level. This relates to the interactions among households in certain gatherings by asking "In the last 12 months, how often has a member of your household participated in the following? Answers were converted to a binary no/yes scale, where 0 indicates "never happens".

We captured and compared the impact of agricultural research and development on various dimensions of social capital. For purposes of comparison, we first created an average

[7] Missing data is associated with households that have a higher educated household head (0.021***), more members (0.008*), more assets (.029***) and bigger houses (.023**). On the other hand, less missing data is also associated with lower membership in farmer associations (-.081**) and smaller houses (-.008***). At village level we find similar patterns where less missing data is associated with more access to schools, health centres and mobile phone networks but also with less access to radio and water.

social capital index, initially assuming that all indicators could be similarly affected by the IAR4D approach. In accordance with an earlier study by van Rijn et al. (see chapter 3), we distinguished between cognitive, structural bonding and structural bridging social capital (see Table 2). Structural social capital includes indicators related to formal and informal networks, whereas cognitive social capital relates to trust and norms of cooperation. The difference between bonding and bridging is akin to indicators capturing within- versus outside village social capital. The latter subdivision only applied to structural social capital, because we considered all our cognitive social capital indicators to be bonding. For this categorisation we normalised the village data to a 0-1 scale. Summary statistics are presented in Table 3.

Table 2: Social Capital Indicators[8] (n=2237)

	Min	Max	Mean	Sd	**1st** order/ **2nd** order	**C**ognitive/ **S**tructural	**Bo**nding/ **Br**idging
Panel A: Happenings							
social gathering	0	4	1.78	1.08	2nd	S	Bo
community project gathering	0	4	2.20	1.36	1st	S	Bo
financial contribution	0	4	1.05	1.07	2nd	C	Bo
village meeting	0	4	1.53	1.14	1st	S	Bo
agricultural visit to agent/organization	0	4	0.37	0.75	1st	S	Br
agricultural visit to other village	0	4	0.29	0.64	1st	S	Br
agricultural visit from other village	0	4	0.31	0.66	1st	S	Br
external agricultural training	0	4	0.60	0.80	1st	S	Br
agricultural visit from agent/organization	0	4	0.86	0.71	1st	S	Br
Panel B: Aspects							
participation in community activities	0	4	2.42	0.87	1st	S	Bo
extent of trust among people	0	4	2.32	0.81	2nd	C	Bo
cooperation among people	0	4	2.47	0.86	1st	C	Bo
giving or exchanging gifts	0	4	2.10	0.99	2nd	C	Bo
financial contr. for comm. activities	0	4	2.03	1.14	2nd	C	Bo
financial contr. to group activities	0	4	1.35	1.21	2nd	C	Bo
spirit of helping others especially the poor	0	4	1.48	1.08	2nd	C	Bo
settling conflicts or disputes among people	0	4	2.78	0.76	2nd	C	Bo
abiding by the norms and byelaws	0	4	2.22	0.94	1st	C	Bo
women confidence to speak in public	0	4	2.36	0.94	2nd	C	Bo
men's respect and consideration of women	0	4	2.35	0.92	2nd	C	Bo
Panel C: Interactions							
community participation	0	1	0.76	0.43	1st	S	Bo
community financial contribution	0	1	0.66	0.47	2nd	C	Bo
settling conflicts	0	1	0.60	0.49	2nd	C	Bo
agricultural learning in community	0	1	0.43	0.50	1st	S	Bo
agricultural between communities	0	1	0.32	0.46	1st	S	Br
visiting research institutes	0	1	0.13	0.34	1st	S	Br
visiting in extension office	0	1	0.15	0.36	1st	S	Br

[8] We are aware of the fact that certain indicators seem to measure comparable issues (e.g. community gatherings and village meetings). However we adopt the existing list since this was an outcome of

In practice, the IAR4Dness approach puts more emphasis on specific aspects of social capital, identified as the "first order" indicators in Table 2. These indicators were mostly related to the direct potential outcomes or impact of the IP and included village and community gatherings related to agricultural extension. At the same time, our social capital indicators were highly interdependent, and we expected (at least in the long term) that part of the impact will trickle down to the other social capital indicators. This was captured by the set of "second order" indicators. We noted that the first order indicators were spread across all dimensions, although relatively more in the area of structural bridging (8 out of 8 indicators), followed by structural bonding (3 out of 6) and lastly cognitive bonding (3 out of 14) social capital. We would like to stress that the IP is the immediate outcome of the IAR4Dness approach. First order indicators are therefore not necessarily project activities, but rather project outcomes or impacts.

Table 3: Social capital dimensions (n=2237)

	Min	Max	Mean	Sd
1. Total index of social capital	0.10	0.77	0.42	0.11
2. Cognitive bonding social capital	0.00	0.92	0.53	0.13
3. Structural bonding social capital	0.04	0.96	0.53	0.18
4. Structural bridging social capital	0.00	0.91	0.15	0.16

4.3.3 Empirical model

To empirically test for the potential of agricultural research and development interventions to influence social capital we estimate the nth dimension of social capital (SCn) as a function of participation in IAR4D or ARD, household control variables (X) and village control variables (Y), a set of country dummies (Z) and a dummy variable that indicates whether it is a new site or not ($newsite$):

$$SC_{n,i} = f_{1,n}(IAR4D_j, ARD_j, X_i, Y_j, Z, newsite)\ ,\ n \in 1,2,3,4 \quad (1)$$

The nth dimension of SC is measured for household *i* in village *j* in 2010 (see Table 3). $IAR4D$ captures the effect of integrated agricultural research for development, whereas ARD captures the effect of traditional agricultural research and development, for village *j*. To control for

intensive discussion and collaboration between a wide range of people and organisations experienced in collection of survey data across Africa.

potential bias of various household or village characteristics, we incorporated the set of household covariates (X) and village covariates (Y) as listed in Table 1. Because a clear consensus on the determinants of social capital has not yet developed in the relevant literature, we included a very basic set of covariates relating to households' demographics, education, assets, farm experience, access to extension and membership in farm organisations (also see Beard 2005). We included several covariates to capture village access to rural services. Because we expected the programme to influence some of these variables, we used baseline data measured in 2008. Finally, we included country dummies (Z) to indicate country-specific effects and a dummy *newsite* for those villages where IAR4D was implemented in 2009. This is to control for the fact that the program was implemented with a one-year delay in approximately 25% of the villages. We estimate the model using Ordinary Least Squares and, because treatment was at village level, we cluster the household error term ε_i at village level *j*. This should prevent unobservable factors at the village level that can influence social capital, for example recent or historical external shocks, from biasing our estimations.

Besides estimating the overall potential of influencing social capital, we also hypothesised that this might depend on the socio, economic or institutional context within which an intervention is implemented. Therefore, we also estimated our model (1) separately for the DRC, Rwanda and Uganda.

4.3.4 Robustness analysis

To make our empirical results more robust we test for the effect of agricultural extension services on social capital using four alternative models. As a first robustness test we used an alternative sample, including only control households selected from the "clean" villages, i.e. the same pool from which the treatment villages were selected. We also excluded villages where the programme was implemented with a one-year delay. This reduced our overall sample from 2019 to 936, and resulted in the following model:

$$SC_{n,i} = f_{2,n}(IAR4D_j, X_i, Y_j, Z, newsite),\ n \in 2,3,4 \quad (2)$$

As a second test of robustness, we took advantage of the fact that social capital data were also collected in the baseline survey for almost 50% of our sample. Using a fixed effects model, we control for unobserved and time invariant household effects that might influence social capital, such as the general tendency or ability to socialise or network. To prevent a bias in our results, we only included data of IPs collected in both years and data on the treatment and

corresponding control villages. This reduced our data set to 968 households, covering 3 IPs in DRC, 1 in Rwanda and 2 in Uganda.

$$SC_{n,i} = f_{3,n}(IAR4D_j * year, ARD_j * year, X_i, Y_j, Z, newsite, year),\ n \in 2,3,4 \quad (3)$$

The interaction terms between the treatment and the year dummy (0 for baseline, 1 for 2010) give the average treatment effect. The time dummy (year) was also included separately to pick up any time effects.

A third test of robustness relies on propensity score matching (PSM). PSM is an alternative method to control for observed pre-treatment differences between our treatment group and control groups (Rubin 1979). We use the propensity scores to estimate the probability of a village to participate in IAR4D village. The propensity score (P) is estimated for household *i* as a function of pre-treatment household or village control variables (X and Y)

$$Pz_i = f_{4,z}(X_i, Y_j,) \quad (4)$$

We calculate Pz_i for country z for two counterfactuals; one based on clean villages and one based on conventional ARD villages. We include those pre-treatment variables which jointly determine treatment propensity at p<20%[9]. Based on these probabilities a control group is selected using stratification matching. We eliminate households from our sample that fall outside the common support, i.e. households that do not have potentially comparable households with a different treatment status. This approach nets out the impact of additive and observable fixed factors on project outcomes (Ravallion 2005). After the matching, the mean social capital indicators in the IAR4D group are compared to those in the control group. To enhance robustness of the estimates, the error term was bootstrapped (see Caliendo and Kopeinig 2005 for more technical details on psm). We estimate the propensity score using a logit model to confine values between 0 and 1.

In the final robustness test, we used an alternative method to aggregate our social capital dimensions. In our main analysis we assumed that the individual indicators have equal

[9] We use a backward selection method with a 20% significance level (P > |t| = <.20) meaning that the first model includes all variables and variables are deleted one by one if not significant at 20%. The significance level was chosen to overestimate rather than underestimate the role of the covariates in determining the impact on social capital. Using this cut-off point we include almost all variables which demonstrate significant differences for the specific treatment and control group (results not reported in his paper but available upon request).

weights and are additive in nature. As another approach, in accordance with Sabatini (2005), we used the first factor obtained from a principal component analysis (PCA) performed on the group of indicators in each dimension. This factor analysis was done separately for the country models. This factor captures the correlation between the different indicators. This model is identical to model (1), except that we replaced the social capital dimensions with their first principal component.

4.4 Results

4.4.1 Mean comparison social capital indicators

As a first step in our analysis, we compared the mean values of the individual social capital indicators (see Table 2) of households in IAR4D villages with household in control villages in 2010. Table 4 clearly shows that households from IAR4D villages have mostly higher levels of social capital.

IAR4D villages scored higher in relation to frequency of agricultural visits to organisations, agricultural visits from and to other villages and external agricultural training and visits (H5-9). In addition, they scored higher than clean control villages in terms of frequency of social and community project gatherings (H1-2), and making financial contributions to community projects (H3). However, the differences in various aspects of village social life are not as clear. In relation to participation in community activities, there is a significant and positive difference compared to clean villages, although this difference is negative compared to ARD villages (A1). Moreover, IAR4D villages scored lower in terms of "giving and exchanging gifts" (A4). This is also the case for "financial contribution to community activities" (A5) and "spirit of helping others especially the poor" (A7) compared to clean villages and for "cooperation among people" (A3) compared to ARD villages. But there is a positive difference in terms of "abiding to norms and byelaws" (A9) and "men's respect and consideration of women" (A11), the latter only being significant compared to ARD villages. This mixed result is perhaps not surprising, since most of these indicators are either not potential first order outcomes of the IP (see Table 2) or refer to a dimension of social capital that is likely to respond to change more slowly (i.e. trust and norms of cooperation).

Table 3: Mean values social capital indicators by treatment (n=2237)

	IAR4D	Control 1: clean			Control 2: ARD		
	N=676	N=772			N=789		
	Mean	Mean	diff		Mean	diff	
Panel A: Happenings (H)							
social gathering	1.905	1.519	0.386	***	1.930	-0.025	
community project gathering	2.284	2.019	0.265	***	2.303	-0.019	
financial contribution	1.087	0.951	0.137	**	1.122	-0.034	
village meeting	1.578	1.490	0.089		1.536	0.042	
agricultural visit to agent/organization	0.479	0.310	0.170	***	0.331	0.148	***
agricultural visit to other village	0.359	0.222	0.138	***	0.295	0.064	*
agricultural visit from other village	0.422	0.233	0.188	***	0.293	0.129	***
external agricultural training	0.688	0.521	0.167	***	0.603	0.085	*
agricultural visit from agent/organization	0.954	0.749	0.205	***	0.876	0.078	*
Panel B: Aspects (A)							
participation in community activities	2.422	2.282	0.139	***	2.548	-0.126	***
extent of trust among people	2.349	2.289	0.060		2.317	0.032	
cooperation among people	2.417	2.483	-0.066		2.503	-0.086	*
giving or exchanging gifts	1.957	2.070	-0.113	**	2.241	-0.284	***
financial contr. for comm. activities	1.979	2.101	-0.122	**	1.997	-0.018	
financial contr. to group activities	1.357	1.348	0.008		1.332	0.024	
spirit of helping others especially the poor	1.425	1.522	-0.097	*	1.480	-0.056	
settling conflicts or disputes among people	2.791	2.802	-0.010		2.750	0.041	
abiding by the norms and byelaws	2.365	2.082	0.284	***	2.228	0.137	***
women confidence to speak in public	2.354	2.364	-0.010		2.349	0.005	
men's respect and consideration of women	2.402	2.364	0.038		2.286	0.116	**
Panel C: Interactions (I)							
community participation	0.768	0.763	0.005		0.736	0.031	
community financial contribution	0.688	0.649	0.039		0.645	0.043	*
settling conflicts	0.646	0.598	0.048	*	0.574	0.072	***
agricultural learning in community	0.429	0.443	-0.014		0.428	0.001	
agricultural between communities	0.288	0.325	-0.037		0.330	-0.041	*
visiting research institutes	0.146	0.133	0.013		0.122	0.025	
visiting in extension office	0.176	0.154	0.022		0.133	0.043	**

* p<0.10 ** p<0.05 *** p<0.01 (significantly different from the treatment group)

At the household level, the most significant and surprising difference related to settling conflict (I3). Interestingly, the impact was even higher compared to conventional ARD villages. It appears as if conventional ARD has not only "failed" to influence this, but might even have influenced it negatively. Finally, household data seems to indicate that households from IAR4D villages were involved in less agricultural exchange between communities, especially compared to ARD villages. This is not only counter to expectations, but also contradicts the results from the village indicators.

To gain more insight into the overall impact of IAR4D and to evaluate how it relates to the impact of ARD, we grouped the dimensions as shown in Table 2. The results confirmed the significant differences in social capital compared to clean villages, reflected in both forms of structural social capital. Compared to ARD villages, there was only a significant difference in relation to structural bridging social capital. There was no significant difference in terms of cognitive social capital. These results adequately summarise the observations made on the individual indicators.

Table 4: Mean values social capital dimensions by treatment (n=2237)

	IAR4D	**Control 1: clean**		**Control 2: ARD**	
	n=676	**n=772**		**n=789**	
Total index of social capital	0.427	0.407	0.020 ***	0.418	0.009
Cognitive bonding social capital	0.167	0.140	0.027 ***	0.148	0.019 **
Structural bonding social capital	0.541	0.506	0.035 ***	0.541	0.000
Structural bridging social capital	0.535	0.526	0.009	0.529	0.007

* p<0.10 ** p<0.05 *** p<0.01 (significantly different from the treatment group)

4.4.2 Regression results, social capital dimensions - pooled model

We then explored the relationship between our social capital dimensions and both forms of agricultural extension services using regression analysis with Model (1). Besides adding several control variables (Table 1), by clustering the error term at the village level we took into account the possibility that the level of social capital is partly explained by unknown and unobserved factors at the village level.

Table 5: Results pooled model (n=2236)

	SC	Struc-Brid	Struc-Bond	Cognitive
IAR4D	0.019	0.035	0.026	0.005
	(0.013)	(0.016)**	(0.017)	(0.017)
ARD	0.010	0.001	0.035	0.004
	(0.012)	(0.013)	(0.015)**	(0.018)
control var.	yes	yes	yes	yes
adj. R-sq	0.118	0.149	0.337	0.048

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Note: coefficients of control variables (Table 1) are not reported but available upon request

This clustering of errors at the village level changed the significance of the results considerably. Apparently, the positive difference referred to above is only partly explained by the implementation of IAR4D. At first, it seemed that IAR4D had no significant impact on social capital. However, when we disaggregated our social capital indicator as specified in the methodology we found a positive and significant impact on structural social capital, especially on facets capturing bridging networks linking the village to the outside. Initially the size seems small (0.0345**), but compared to the average level of this dimension (0.15) this means that IAR4D, all other variables held constant, resulted in an average increase in the structural bridging social capital index of 23%. It is interesting to note that conventional ARD did not have any impact in this area, except where the impact of IAR4D on bonding structural social capital was most limited. In that case, ARD appeared to have a significant influence (0.0347**). There was no overall impact on cognitive social capital.

4.4.3 Regression results, social capital dimensions - country models

We analysed Model (1) at the country level to determine the importance of the context in which IAR4D was implemented. The large size and significance of our country dummies in the pooled model appeared to suggest that it does. Because we found that the impact of agricultural research for development varies according to the dimensions of social capital used, we excluded our overall social capital index from further analysis.

The effect of IAR4D on structural bridging social capital was confirmed and was strongest for the DRC. After controlling for control variables and unobserved village effects, IAR4D was associated with an increase of 41% (0.858*/0.21 average for the DRC) in structural bridging social capital. The same is true for ARD, although the size is much smaller

(20%). For Uganda, the impact of IAR4D was also significant, indicating an increase of 27% (0.0260**/ 0.0930 average for Uganda). For Rwanda, the impact was very small and not significant. The impact of ARD on structural bonding social capital in the pooled model was no longer visible. More generally, there was no impact on this area of social capital, even though coefficients are positive and nearly significant for IAR4D in Rwanda and for ARD in Uganda. This lack of impact was also true for cognitive social capital, where the signs of the coefficients were actually negative in the case of Rwanda. For the DRC, on the other hand, the coefficient seemed to point towards a positive impact (0.0568 on an average of 0.49 for the DRC) with a significance level of 22%. The results thus indicate significant country heterogeneity in the effect of agricultural research and development interventions on various dimensions of social capital.

Table 6: Results country models

		Struc-Brid	Struc-Bond	Cognitive
DRC	IAR4D	0.086	0.024	0.057
(n=767)		(0.047)*	(0.047)	(0.046)
	ARD	0.042	0.042	0.010
		(0.025)*	(0.031)	(0.038)
	control var.	yes	yes	yes
	adj. R-sq	0.087	0.013	0.042
Rwanda	IAR4D	0.000	0.041	-0.012
(n=660)		(0.023)	-0,025	(0.023)
	ARD	-0.034	0.032	-0.022
		(0.0258)	(0.0231)	(0.0189)
	control var.	yes	yes	yes
	adj. R-sq	0.050	0.118	0.061
Uganda	IAR4D	0.026	0.006	0.003
(n=809)		(0.012)**	(0.016)	(0.020)
	ARD	-0.005	0.028	0.020
		(0.012)	-0,018	(0.029)
	control var.	yes	yes	yes
	adj. R-sq	0.061	0.044	0.083

* p<0.1, ** p<0.05, *** p<0.01

Note: coefficients of control variables (Table 1) are not reported but available upon request

4.4.4 Robustness analysis

Below we describe the robustness of our results according to the models specified in section 4.3.4. Results are presented in Appendix 4.1. Due to the proven country heterogeneity, we continued this analysis at the country level.

As a first robustness test we used an alternative sample excluding the new sites and traditional ARD villages (see results model 2 in Appendix 4.1). For the DRC, the size and significance of impact on structural bridging social capital increased to 0.102** (48%). In addition, the impact on cognitive social capital became significant at 10% (0.114**). For Rwanda the results were also more convincing, increasing in size and significance for structural bonding social capital (0.0466**). For Uganda, the results remained roughly the same, although slightly less significant. The impact of IAR4D on various dimensions of social capital as referred to in the previous section was thus confirmed and even strengthened.

Second, we used a sub-sample of our villages (those for which social capital was correctly gathered in the baseline) to run a time series model in which we controlled for unobserved time invariant household and village characteristics (see results model 3 in Appendix 4.1). For the DRC, the impact increased in size for structural bridging social capital and became significant for bonding social capital. For Rwanda, the impact on bonding social capital became significant at 10%. The results for Uganda became slightly less significant, decreasing the significance of the impact on structural bridging social capital to slightly over 10%. For ARD, no significant positive impact on social capital was confirmed. In fact, we observed a significant negative impact in Rwanda.

As a third test of robustness we used a PSM (see results model 4 in Appendix 4.1)[10]. Overall we see that the results of model 1 are confirmed and increase in significance[11].

[10] In almost all cases we were able to calculate the propensity score and fulfil the balancing property by using the logit model as proposed in our method section. This means that all control variables included in the model have equal mean values across our treatment and control group. In two cases, the model for ARD in Rwanda and Uganda, we had to eliminate the availability of health centres as a village characteristic from our estimation to fulfil the balancing property. The models used for calculating the propensity score differ by country and by control group. Pre-treatment variables often included are the age of household head, household assets, number of rooms in the house, access to boreholes/wells, radio coverage and mobile phone coverage. The sign and significance of the variables do not point at an obvious selection effect. The only exception might be assets, which is consistently higher in IAR4D

Moreover, the model confirms some of the impacts found in our previous robustness models: the impact of IAR4D on cognitive bonding social capital in the DRC, the impact of ARD on structural bridging social capital and IAR4D on structural bonding social capital in Rwanda.

In a final robustness test we used an alternative method to aggregate our social capital indicators: a principal component analysis (see results model 5 in Appendix 4.1). For the DRC the effect of IAR4D on structural bridging social capital was confirmed and strengthened. This was also true for structural bonding social capital in Uganda and Rwanda. Using the factors instead of the composite measures of social capital also resulted in a significant impact of ARD on structural bridging social capital in the DRC, though of a smaller size. Moreover, there appeared to be an impact of ARD on bonding social capital in all three countries, which was also seen in the initial pooled model referred to in Section 4.4.2.

Although the robustness analysis appeared to indicate some inconsistency regarding the exact size or significance of our results, the main conclusions did not change. First, it confirmed that IAR4D indeed resulted in significant change, mainly in bridging social capital in the DRC and Uganda. Second, the robustness analysis confirmed the impact on bonding social capital in Rwanda. Finally, the analysis showed a stronger impact on cognitive bonding social in the DRC. For ARD, the impact on social capital was weak, and this was confirmed in our robustness analysis. In fact, there was as much proof for a negative impact (especially in Rwanda) as there was for a positive impact (especially in the area of bonding social capital).

4.5 Discussion

The results clearly show that IAR4D, compared to ARD, has successfully influenced social capital in the Lake Kivu area. We found no consistent impact for ARD, which supports the argument that many of the conventional agricultural extension services in Africa still assume that research, technology transfer and technology adoption are independent activities (e.g. Leeuwis and Van den Ban 2004; Röling 2009). If extension was indeed viewed as a process of

villages in DRC and Uganda. The potential selection effect is contradicted by the fact that in these same models either the number of rooms or access to certain village resources is consistently lower.

[11] These results are robust to different matching methods (kernel and nearest neighbour matching). The results of our main model (model 1) and the fixed effects model (model 3) are also robust to estimation on the common support. This means we exclude 1 household for DRC, 38 for Rwanda and 29 for Uganda. Results are available upon request.

interdependence among actors, joint learning and social interaction – as proposed by those authors – then at least some changes should have been visible in our indicators of social capital. The context within which these extension services are embedded is still largely overlooked. We did find these changes as a result of IAR4D, which could be promising for development outcomes such as agricultural innovation. Nevertheless, the impact of IAR4D depends greatly on the dimension of social capital that is used and the country in which the programme was implemented. In this section, we offer several potential explanations for these mixed results.

First of all, the heterogeneity of results across social capital dimensions could be due to the nature of the IAR4D intervention. This approach brings together stakeholders in the agricultural sector – including farm households, local government agencies, scientist, NGOs and traders – essentially forming a platform for the creation of bridging social capital. The first/second order column in Table 2 shows that this is clearly reflected in the intervention approach. This does not mean social capital increases in the long-term after the project ends. But given that participation in IAR4D was voluntary and that external participants only facilitated the IP process, the results in Table 2 suggests that during the project implementation, social capital changed due to project implementation. Hence, we would like to stress again that the IP is the immediate outcome of the IAR4Dness approach and this might (or might not) results in an increase in social capital after project ends. In fact, not all countries show an increase in structural bridging social capital as a result of IAR4D. At the same time this result shows that a second order impact, which is plausible considering the interrelatedness of the different indicators, is not yet visible.

An alternative explanation for this result is that structural social capital is simply easier to influence with short-term external interventions. Although some authors believe that social capital is historically derived, this argument is perhaps more applicable to cognitive social capital. At the same time, the results for the DRC should be considered; they tend to support the notion that trust and norms of cooperation might be less historically derived than is often assumed (also see Fearon et al. 2009; Labonne and Chase 2011).

Besides heterogeneity across dimensions, we also found heterogeneity across countries. The success of IAR4D might depend on the socio, economic or institutional context in which it is implemented. Although we cannot test this hypothesis with our current data, we can suggest four possible explanations. First, we looked at the baseline differences at the household and village levels (Table 1). Any of these characteristics could interact with the

programme, making it more effective. Although we found several notable differences – for example, households in the DRC were less well connected and households in Uganda had more access to extension services in the past – we did not find any convincing statistical evidence that this aspect plays a role[12]. Only two variables were significant: the highest level of education within the household in the case of bridging social capital (0.0067*), and access to schools at the village level in the cases of cognitive social capital (-0.0708**) and structural bonding social capital (0.0678**). This suggests that education might play a role in the success of the IAR4D approach, though the direction would depend on the dimension of social capital.

A second reason for the differential impact across countries might be because of differences in pre-existing levels of social capital (descriptive data available upon request). During both years, the DRC apparently had higher levels of bridging social capital than Rwanda or Uganda. IAR4D, in which building bridging social capital is vital, could thus be more successful in a region where people have already formed such linkages and are comfortable (perhaps more trustworthy) with such collaboration. Likewise it is possible that we identified an effect on structural bonding social capital in Rwanda simply because people there were already more inclined to cooperate at the village level. At the same time, the DRC has lower levels of cognitive social capital; we measured a noteworthy impact of this dimension only in the DRC (but the effect was not significant at less than 10%). Due to the lack of full baseline data, we cannot confirm these hypotheses at present, although it is a topic to on-going research.

Another explanation concerns differences at the macro level, especially those related to higher-level institutions of governance. For example, on various governance indicators from the Worldwide Governance indicators project, the DRC scored much lower than Uganda and Rwanda (an average of 4.92 versus 42.24 and 38.12). This could indicate that the payoff of an IAR4D approach is higher in an environment with a lack of formal institutions, which

[12] In our pooled model we include interaction terms of our control variables with the IAR4D treatment dummy. Results are not reported here but available on request.

increases the need for more informal types of institutions that regulate behaviour (Ahlerup et al. 2009)[13].

A final explanation for the heterogeneity in results might be that IAR4D was actually implemented differently in different IPs. On the one hand this is inherent to the approach – i.e. adapting to local circumstances – but on the other hand it could simply be that some IPs are managed more effectively than others. In accordance with Pamuk et al. (2012), we therefore replaced our IAR4D treatment dummy with 12 IP dummies, four in each of our country models (see Appendix 4.2). Part of the impact at the IP level was confirmed according to our expectations; for others it was surprisingly insignificant or even negative. Further research should show whether this result is robust, and – taking into account the alternative reasons for heterogeneity as discussed above – what the reasons for this mixed result could be (also see chapter 5)

4.6 Conclusion

The literature on social capital and the significant role it plays in development is constantly increasing. However, it is still unclear under which conditions the benefits of social capital accrue or whether they are in fact always positively related to economic development. Nevertheless, development aid has invested significantly in efforts to increase social capital. Many participatory projects in rural Africa are efforts to enhance development indirectly by promoting cooperation in formal or informal networks, and by encouraging trust and norms of behaviour towards mutually beneficial action. But it remains unclear whether external interventions can actually influence social capital, especially in the short term.

One initiative where social capital has a role is in Integrated Agricultural Research for Development, as adopted by the Sub Saharan Africa Challenge Programme (SSA CP). This approach relies on Innovation Platforms (IPs) which is an informal coalition, partnership and alliance of conventional agricultural research and development actors. Using semi-experimental data collected in the context of the SSA CP, we showed that IAR4D has influenced social capital, although not in all its dimensions and not consistently for all countries. Furthermore, we showed that traditional forms of agricultural extension (ARD) have been less successful.

[13] An alternative hypothesis that macro level institutions and (local) social capital are complements rather than supplements (Woolcock 2001), is also possible but not apparent in this context.

More specifically, we found that IAR4D has influenced networks that link the village to the outside (structural bridging social capital) in the DRC and Uganda. The networks inside the village (structural bonding social capital) and trust and norms of cooperation inside the village (cognitive bonding social capital) did not change significantly as a result of the programme. However, our robustness analysis indicated two possible exceptions. In Rwanda, the impact of IAR4D on structural bonding social capital was already significant at 15% in our main model and this effect is confirmed by all our robustness models. In DRC, we find a significant impact of IAR4D on cognitive bonding social capital in two out of four models. Both results could indicate a more durable impact of IAR4D on social capital and should be explored in future research. The end line survey which is has been recently approved for the LK PLS of the SSA CP in 2013 will provide ample opportunity to evaluate how social capital developed after end of the first phase of the project, especially considering the fact that most IPs now operate independently.

We speculate that the heterogeneity across different dimensions of social capital might result from the nature of the intervention, which focuses primarily on the creation of structural bridging social capital. Alternatively, structural social capital might simply be easier to influence. We argue that heterogeneity across countries could result from the different socio, economic or institutional context in which IAR4D was implemented. We explored the effects of household and village baseline conditions, levels of social capital and macro level institutions, but we cannot offer any solid statistical proof for these hypotheses. Finally, we concluded that heterogeneity across the different IPs could partly explain the mixed results. These results at least imply that both context as well as implementation matter. In other words, it is impossible for "social capital" related projects to deliver predictable outcomes without very explicitly taking into account the differences in context, the diligence with which they were implemented[14] and evaluation of performance of social capital after the project ends.

These results have various policy implications. First of all, we showed that an intervention such as IAR4D can successfully influence the networks linking a village to partners outside the village; this is a dimension of social capital which is generally thought to

[14] We would like to thank an anonymous reviewer for bringing forward this important conclusion. Also see the recent World Bank report "Localizing Development – Does participation work" by Mansuri and Rao (2013) who reach a similar conclusion based on the review of almost 500 studies on participation and decentralization.

be important, if not vital, to economic development. This result was found in two regions with divergent institutional contexts. At the same time, we also showed that this requires specific effort, because ARD, even though it was active for longer time, did not yield similar results. Another implication is that an intervention like IAR4D might not be successful in influencing trust and norms of cooperation in the short term. Both findings are important to the ever increasing number of projects and programmes for which networks, trust and norms of cooperation are either the basis for success or form an outcome as such.

4.7 Appendix

Appendix 4.2: Results country models by IP

		model (1)		
		Struc-Brid	**Struc-Bond**	**Cognitive**
DRC	Bweremana	0.172	0.118	0.102
(n=767)		(0.106)	(0.090)	(0.057)*
	Kituva	0.138	0.032	0.004
		(0.113)	(0.135)	(0.055)
	Rubare	0.085	0.022	0.155
		(0.045)*	(0.068)	(0.059)**
	Rumangabo	-0.014	-0.057	-0.006
		(0.056)	(0.054)	(0.080)
Rwanda	Gataraga	0.025	0.060	-0.047
(n=660)		(0.037)	(0.037)	(0.037)
	Remera	-0.075	-0.049	0.048
		(0.036)**	(0.039)	(0.034)
	Rwerere	-0.003	0.015	-0.058
		(0.025)	(0.047)	(0.053)
	Mudende	0.033	0.120	0.034
		(0.021)	(0.039)***	(0.026)
Uganda	Bufundi	0.016	0.002	0.022
(n=809)		(0.019)	(0.015)	(0.035)
	Bubare	0.041	-0.026	-0.059
		(0.027)	(0.033)	(0.033)*
	Chahi	0.035	0.013	-0.015
		(0.015)**	(0.027)	(0.029)
	Kayonza	0.016	0.033	0.058
		(0.027)	(0.047)	(0.036)

* p<0.1, ** p<0.05, *** p<0.01

Note: coefficients of control variables (Table 1) and ARD coefficient are not reported but available upon request

		model (2)			model (3)			model (4)			model (5)		
		Struc-Brid	Struc-Bond	Cognitive	Struc-Brid	Struc-Bond	Cognitive	Struc-Brid	Struc-Bond	Cognitive	(Struc-Brid	Struc-Bond	(Cognitive)
DRC	*IAR4D*	0.102	0.031	0.077	0.147	0.183	0.114	0,084	0,025	0,06	0.804	0.247	0.381
		(0.046)**	(0.045)	(0.045)*	(0.072)**	(0.077)**	(0.098)	(0.018)***	(0.018)*	(0.018)***	(0.340)**	(0.336)	(0.317)
	ARD				0.056	0.087	-0.016	0,048	-0.015	0,019	0.449	0.388	0.166
					(0.047)	(0.069)	(0.080)	(0.023)***	(0.028)	(0.015)*	(0.176)**	(0.206)*	(0.261)
	control var.	yes	yes	yes	yes	yes	yes	psm	psm	psm	yes	yes	yes
	n	368	368	368	1172	1172	1172	463/485	463/485	463/485	767	767	767
	*R-sq**	0.096	0.036	0.090	0.148/0.079	0.175/0.001	0.135/0.012	na	na	na	0.172	0.046	0.044
Rwanda	*IAR4D*	0.040	0.067	-0.014	-0.037	0.206	0.043	0,02	0,063	-0.011		0.493	-0.140
		(0.025)	(0.027)**	(0.027)	(0.092)	(0.095)*	(0.070)	(0.016)	(0.016)***	(0.010)	(0.247)	(0.250)*	(0.264)
	ARD				-0.111	-0.201	-0.060	0,043	0,006	-.008	-0.396	0.575	-0.152
					(0.041)**	(0.044)***	(0.041)	(0.012)***	(0.010)	0,009	(0.243)	(0.230)**	(0.220)
	control var.	yes	yes	yes	yes	yes	yes	psm	psm	psm	yes	yes	yes
	n	344	344	344	266	266	266	423/423	423/423	423/423	660	660	660
	adj. R-sq	0.043	0.197	0.117	0.351/0.002	0.630/0.334	0.758/0.043	na	na	na	0.088	0.182	0.130
Uganda	*IAR4D*	0.026	0.010	0.005	0.081	0.062	0.084	0,025	0,002	-0.005	0.302	0.015	-0.027
		(0.014)*	(0.015)	(0.024)	(0.048)	(0.059)	(0.079)	(0.008)***	(0.016)	(0.009)	(0.102)***	(0.201)	(0.198)
	ARD				-0.010	-0.053	0.058	0,015	-0.003	0,013	0.006	0.519	0.217
					(0.041)	(0.051)	(0.105)	(0.010)*	(0.015)	(0.010)*	(0.106)	(0.281)*	(0.278)
	control var.	yes	yes	yes	yes	yes	yes	psm	psm	psm	yes	yes	yes
	n	376	376	376	498	498	498	526/525	526/525	526/525	809	809	809
	adj. R-sq	0.059	0.026	0.042	0.342/0.155	0.362/0.035	0.248/0.029	na	na	na	0.058	0.110	0.128

* p<0.1, ** p<0.05, *** p<0.01, R-sq refers to adjusted R-sq for model (2) and model (4) and refers to within/between R-sq for model (3)

Note1: model (4) is based on two psm models for IAR4D and ARD; n therefore does not match the other analyses

Chapter 5 Implementation of the IAR4D approach matters: A research on the difference in impact of decentralized innovation systems in Africa

Abstract: Agricultural growth is considered an important instrument for sustainable alleviation of poverty. A relatively new view to boost agricultural growth is the implementation of the innovation system perspective. The Sub Saharan African Challenge Program adopted this as its main philosophy through the Integrated Agricultural Research for Development Approach (IAR4D). Implementation was done through the development local decentralized Innovation Platforms (IPs) in eight countries. Previous research indicates considerable heterogeneity in impact of these IPs. In this paper we argue that this may be because there is heterogeneity in implementation: IPs may not have equally implemented the principles of the IAR4D approach. We test this by quantifying the five defining principles of IAR4D into an IAR4Dness index. Linking these data to the main survey data, we present three main results. First, the index is correlated positively and significantly to the Food Consumption Score (FSC), our proxy for poverty. Second, this effect mainly stems from the effect of two IAR4D sub principles: non-linear, collective and collaborative interaction (principle 2) and institutional and human capacity building for IP actors (principle 5). Third, our analysis indicates that the effect of IAR4Dness on FSC does not operate through increased use of agricultural technologies or increased levels of household social capital.

Paper by Haki Pamuk and Fédes van Rijn.

5.1 Introduction

Agricultural growth is considered an important factor for sustainable alleviation of poverty (Haggblade et al. 2007; Ligon and Sadoulet 2007; World Bank 2007; Christiaensen et al. 2011). Policy makers have applied a wide variety of strategies to boost agricultural productivity and production in developing countries. A relatively new view in those strategies is the implementation of the innovation system perspective to support agricultural research and development for resource poor farmers. The innovation system approach is a multi-stakeholder and participatory method integrating the knowledge of stakeholders from the value chain via so called "innovation platforms (IPs)". At IPs, the stakeholders are expected to come together to find solutions to local bottlenecks and to design and implement policies at the local level (Leeuwis and Van den Ban 2004; Hall et al. 2006; Knickel et al. 2009). Many IPs have recently been introduced to enhance agricultural production and productivity of resource poor farmers through adoption of suitable and efficient agricultural techniques (Nederlof et al. 2011).

However, few evaluation studies have quantitatively explored the impact of these IPs. The exceptions are those studies that assessed the effect of Sub Saharan African Challenge Program (SSA CP). The SSA CP adopted the Integrated Agricultural Research for Development (IAR4D) approach as its main philosophy through the implementation of local decentralized IPs. These studies confirm that, on average, the program reduces poverty (Lynam et al. 2010; Pamuk et al. 2012). Nevertheless, they also show that the IPs have had mixed impacts on poverty, agricultural innovation (Pamuk et al. 2012) and household social capital (chapter 4). Impact analyses on these outcomes at IP level indicate large differences: ranging from significantly positive to non-significant to significantly negative.

The policy evaluation literature suggests two answers to explain the differences in impact at IP level. First, the impact of any policy, in this case the IPs, may be a function of characteristics of the region where the project is implemented (Heckman et al. 1997; Deaton 2010). Second, even if the policy is implemented among the same population, its outcomes may still vary if the policy is implemented by different organisations; the organisations may possess different organisational and managerial capacities and have different efficiency levels (Heckman et al. 1997; Deaton 2010; Allcott and Mullainathan 2012; Bold et al. 2013). The aforementioned studies evaluating the impact of IPs investigate the role of the first factor:

heterogeneity in target population. This paper investigates the role of the latter: heterogeneity in implementation.

In this paper we explore the heterogeneity in implementation of the SSA CP, and the effects thereof on program impact. We argue that differences in program impact might be explained by the extent to which IPs adopted IAR4D. The objective of this paper was twofold. First, to capture heterogeneity in implementation, we quantify the IAR4D criteria and summarise them into an "IAR4Dness" index. Second, we analyse whether differences in impact result from difference in the level of IAR4Dness. We also explore whether certain baseline conditions explain why some IPs are more successful.

Results indicate that implementation matters. IAR4Dness is positively related to the food consumption score, our main outcome variable and proxy for food security. We find that attendance of stakeholders to the activities – in particular to the information sharing activities and field visits – determine how successful IPs are in increasing household food consumption. Nevertheless, we do not find evidence that this relationship results from the adoption of agricultural technologies or increase in household social capital - two of the potential impact channels. In addition, we find tentative evidence that baseline village social capital is related to attendance in IP activities.

This paper is organised as follows. In section 5.2, we give a brief conceptual framework including a description of the SSA CP. In section 5.3 we present our data set. In section 5.4, we describe the IAR4Dness indices and how they differ across IPs. In section 5.4, we analyse whether this index explains differences in impact of the IPs, including a detailed description of our identification strategy and a robustness analysis. In Section 5.6, we have a short discussion on the potential determinants of IAR4Dness. Finally, Section 5.7 concludes.

5.2 Conceptual framework

IAR4D was introduced as part of the SSA CP in 2004. The approach is based on the view of innovation systems. According to this view, innovation is seen as the result of the integration of knowledge from various actors and stakeholders (e.g. Leeuwis and Van den Ban 2004). With IAR4D this approach got form by the creation of decentralized IPs; coalitions of stakeholders to identify and address local bottlenecks to agricultural development. Representatives of farmers' associations, traders, researchers, extension workers, NGOs, and government policy

makers regularly meet at these platforms, articulate their views, and negotiate joint strategies for action (FARA 2008).

To promote external validity, IAR4D was implemented in three African project learning sites (PLSs): (*i*) "Lake Kivu (LK)" in Eastern and Central Africa, (*ii*) "Kano-Katsina-Maradi (KKM)" in West Africa, and (*iii*) "Zimbabwe-Malawi-Mozambique (ZMM)" in Southern Africa. Each region was divided into three sub-regions and in each sub region 4 IPs were implemented covering various villages. In total, 32 IPs became operational[15]. The overall program has been coordinated by the Forum for Agricultural Research in Africa (FARA). However, different agencies have been responsible for the implementation and facilitation of the IPs (see Appendix 5.1 for an overview).

IPs had to fulfil five criteria to abide with the IAR4D approach (FARA 2008; Hawkins et al. 2008): (1) existence of IPs that are representative, inclusive and with diverse partnerships, (2) existence of non-linear, collective and collaborative interaction among IP actors, (3) research addresses key constraints and opportunities agreed by the IP in the context of entire value chains, (4) the research process is multidisciplinary and participatory and (5) there is institutional and human capacity building for IAR4D actors to effectively participate. We define the extent to which IPs abide with these criteria as the level of "IAR4Dness". Because of the decentralized nature of the IPs and the different implementing agencies, we expect to find variation in the level of IAR4Dness.

As is elaborately explained by Haki et al. (2012) and van Rijn et al. (chapter 4) we expect the IAR4D approach to have an impact on poverty through increased agricultural innovation and social capital. Considering the focus of the policy on agricultural production, we chose to measure poverty impact through increased household food security. Increased agricultural innovation is the main channel through which IAR4D aims to enhance agricultural production and reduce poverty. Agricultural innovation can have a direct influence on poverty by increasing productivity, decreasing production cost, or reducing risk for those adopting (De Janvry and Sadoulet 2002). However, the five defining principles of IAR4D also illustrate that the immediate channel of impact on poverty of IAR4D is perhaps not to directly influence agricultural innovation, but to create a setting to enable these outcomes (see chapter 3 and 4 for an overview of why social capital and agricultural innovation are naturally linked).

[15] Although 36 IPs were to be established 4IPs in ZMM never became operational and data were not collected for those IPs.

Therefore, household social capital is considered an important intermediate outcome variable. The consideration of social capital as an immediate outcome indicator is in line with the innovation system perspective.

5.3 Data description

5.3.1 Sample

The IAR4D program was implemented as a large experiment. This meant some communities "received" IPs (treatment communities) and others did not (control communities). To promote internal validity there was exogenous selection of villages into the IAR4D treatment. Even though details of the sampling frame were slightly different across the different regions it generally followed a randomized controlled trial approach (see FARA 2009; Pamuk et al. 2012 for details on the sampling frame). Within each village, a random sub-sample of 10 respondents (households) was drawn from treatment and control villages. Baseline and midline data were collected at village and household level in 2008 and 2010/2011. In this paper, we focus on treatment villages because we are interested in differences in impact within the treatment community.

5.3.2 IAR4Dness

To determine the level of IAR4Dness we used the data collected in a small survey among IP coordinators by email in mid-2012 (see Appendix 5.2 for the details of the survey). This survey included questions capturing the five IAR4D criteria. The first principle is captured by the number of different types of stakeholders involved[16]. The second principle was captured by the level of involvement of the stakeholders in different activities, and the variance in involvement of different types of stakeholders. The third principle was captured by the percentage of different stakeholders involved in problem identification and the percentage of problems prioritized and acted upon. The fourth principle was captured by stakeholders' involvement and implementation of activities and the percentage of different stakeholders involved in the policy design. The fifth indicator was captured by stakeholders' involvement in capacity building activities including information sharing, training and field visits. For all indicators we calculate the average of those stakeholders involved and/or those problems identified, and

[16] Stakeholder include farmers, researchers, extension agents, marketing organisations, policy makers, NGOs, input suppliers, traders, private businesses and others.

normalise data from 0 to 1. Summary statistics are provided in Table 1, where higher values mean higher scores in terms of IAR4Dness.

Table 1: IAR4Dness variables (n=32)

Principle	Definition	Mean	Sd	Min	Max
Principle 1	Number of stakeholders involved	0.75	0.15	0.55	1
Principle 2a	Average involvement in listed activities	0.78	0.14	0.54	1
Principle 2b	Difference to average participation*	0.77	0.17	0.27	1
Principle 3a	% Of stakeholders involved in problem identification	0.33	0.2	0.08	1
Principle 3b	% Of problems identified being prioritized and addressed	1.00	0.00	1.00	1
Principle 4a	Average involvement joint planning and implementation	0.77	0.13	0.55	1
Principle 4b	% Of stakeholders involved in policy formulation	0.45	0.27	0.08	1
Principle 5	Average involvement in information sharing and field visits	0.77	0.16	0.44	1

Note: all variables are normalised in the range [0,1]
*this indicator is rescaled so that smaller variances (more equality) is reflected by higher scores

5.3.3 Outcome variables

We use household level of household food security as the main outcome variable, and agricultural technology and household social capital as the two intermediary outcome variables (see Panel A of Table 2). For the measurement of household food security, we employ the Food Consumption Score (FCS) index measuring monthly food consumption of respondents of food items consumed in the last 30 days, weighted by the nutritional value added. To measure agricultural technology, we use count data indicating how many technologies households adopt with respect to soil and water management, soil fertility management, crop management, and post-harvest storage (see appendix 3.1 in chapter 3 for more details). Finally, for household social capital we construct an index measuring the level of interaction of a household with other villagers, farmers, researchers and extension agents[17].

[17] To construct the social capital index, we first create seven dummy variables (equal to 1 if household is involved in the following activity, 0 otherwise) regarding household's participation in community development projects, financial contribution for community activities or collective problems, involvement in settling conflicts or disputes among people, visiting other farmers within your community to learn about agriculture, visiting other farmers outside your community to learn about agriculture, visiting a research station to learn about agriculture ,visiting an extension office to learn about agriculture. The index is the weighted average of these dummy variables.

Table 2: Outcome variables and household and village characteristics

Variable	Obs*	Mean	Sd	Min	Max
Panel A: Outcome variables					
Index of social capital	2658	0.5	0.3	0.00	1.00
Total number of innovations	3103	8.1	4.00	0.00	19.00
Monthly food consumption score	3322	205.6	91.9	0.00	465.00
Panel B: Household characteristics					
Male household head	3456	0.7	0.4	0.00	1.00
Age of household head	3433	46.6	14.7	16.00	105.00
Education level of household head**	3242	3.3	2.3	1.00	10.00
Household size in logarithms	3436	1.9	0.6	0.00	4.8
Panel C: Village characteristics (dummies)					
Village	332	0.66	0.47	0.00	1.00
Hospital	322	0.3	0.46	0.00	1.00
Worship place	339	0.81	0.39	0.00	1.00
Social hall	302	0.22	0.42	0.00	1.00
All wheather road(s) connected to the village	315	0.73	0.44	0.00	1.00
Mobile network connection	336	0.88	0.33	0.00	1.00
Panel D: Village social capital variables					
Participation in community activities	129	2.8	1.00	0.00	4.00
Extent of trust among people	128	2.6	1.00	0.00	4.00
Cooperation among people	126	2.7	1.00	0.00	4.00
Giving or exchanging gifts	130	2.2	1.1	0.00	4.00
Financial contribution for community activities	130	2.4	1.2	0.00	4.00
Extent of financial contribution to group activities	128	2.3	1.2	0.00	4.00
Spirit of helping others especially the poor	129	2.00	1.4	0.00	4.00
Settling conflicts or disputes among people	128	2.9	1.00	0.00	4.00
Abiding by the norms and byelaws	131	2.6	1.1	0.00	4.00
Women confidence to speak in public	131	2.5	1.00	0.00	4.00
Men's respect and consideration of women	131	2.7	1.00	0.00	4.00
Panel E: Instruments					
Equals to 1 if start IP activities > 1.5 years	32	0.34	0.48	0.00	1.00
Years after start of IP activities	32	1.55	0.70	0.50	2.50

*Number of observations are at households level (Panel A&B), village level (Panel C&D) and IP level (panel E) ** 0 - (no education)-10 (university or higher)

5.3.4 Household and village characteristics

To control for differences in IP context, and for their potential influence on project implementation, we use various household and village level variables (see Panel B and C of Table 2). Our household level variables include gender, age, formal education level of household head, and household size. Our village level variables include a list of village amenities. To explore whether the level of cohesion in the community affects IP performance we include a third set of variables, namely baseline village social capital (Panel D of Table 2). These are different indicators than our social capital outcome variable which was measured and defined at household level. The information regarding village level social capital was collected during community discussions by asking participants to evaluate social cohesion in their village from 0-4 according to several questions. They do not include information regarding interaction of the villagers with others. Instead they measure the quality and order in social life.

5.4 Capturing the level of IAR4D into an "IAR4Dness" index

We used three approaches to capture the level of IAR4Dness. The first is an aggregate index of the indicators which is the sum of five principles weighted according to the principle they represent. This reflects the idea that IAR4Dness is best captured by the different components rather than by its separate components. However, we also want to explore whether certain components matter more. Therefore, a second approach is the decomposition of the aggregate IAR4Dness index according to the five principles listed before. This means we create an average of principle 2a and 2b, 3a and 3b, and 4a and 4b. A third, and more data-driven approach, is to look at the actual correlation between the different IAR4Dness variables. To structure these correlations and create new components we use factors extracted from principal factor analysis. The number of factors, and thus components, is determined by the variance extracted within each factor, or eigenvalue. According to the Kaiser criterion, only factors with an eigenvalue above 1 are retained. We use a varimax rotation method to maximize the variance across factors. (see Kaplan 2008 for more technical details).

We shortly present the IAR4Dness indices in Table 3. There is relatively little variance in aggregate IAR4Dness index with a mean of 0.74 and a standard deviation of only 0.07. However, the variation of the individual principles is a bit higher indicating differences between the IPs. The factor analysis results in two factors (see Appendix 5.2). The first factor mainly captures higher participation in activities organised by the IP. The second factor captures higher number of stakeholders involved and a more equal involvement. Both factors

also capture a lower percentage of stakeholders involved in problem identification or policy formulation. This indicates that, perhaps not surprising, even though more stakeholders are involved in the IP, not all of these stakeholders are represented when it comes to problem identification or policy formulation.

Table 3: IAR4Dness indices (n=32)

Variable	Definition	Mean	Sd	Min	Max
IAR4Dness	Aggregate index	0.71	0.07	0.56	0.82
Principle 1	Representative, inclusive and diverse	0.75	0.15	0.50	1.00
Principle 2	Non linear, collective and collaborative	0.77	0.11	0.54	0.95
Principle 3	Key constraints and opportunities addressed	0.66	0.10	0.54	1.00
Principle 4	Multidisciplinary and participatory	0.61	0.16	0.41	0.97
Principle 5	Capacity building	0.77	0.16	0.44	1.00
Factor 1	↑ Participation in activities +↓ % involved in problem iden.	0.00	1.00	-1.66	1.83
Factor 2	↑ Nr of stakeholders +↓ % involved in policy formulation	0.00	0.99	-2.45	1.57

5.5 The relation of IAR4Dness to outcomes variables

5.5.1 Identification strategy

In this section we investigate whether IAR4Dness affects IP performance. To control for the potentially confounding effect of household, village and IP level characteristics on our outcome variable and IAR4Dness, we use data from the baseline survey conducted in 2008 and the midline survey conducted in 2010/2011[18], and define our outcome variables at household level whereas our IAR4Dness variables are defined at IP level. For this reason, we cluster standard errors at IP level in the estimations.

We estimate the n^{th} outcome variable (Y) for household *i* in year *t* as a function of IAR4Dness (I) for IP *p*, household control variables (X) for household *i*, village control

[18] Ideally, we would use baseline and midline data from village surveys to control for the potentially simultaneous impact on our outcome variables through increased village amenities and IAR4Dness. However, midline village data was only collected for LK PLS. To be able to use the available information for LK, we extrapolate the information concerning village resources for KKM and ZMM by using baseline surveys, and assume that they are same in baseline and midline periods.

variables (Y) for village *j*, a year dummy (Midline), a set of region dummies (Z) (usually corresponding to country level), and IP level fixed effects (*IP*):

$$Y_{n,it} = f_{1,n}(I_{pt}, X_{it}, Y_{jt}, Midline_t, Z * Midline_t, IP_p), \; n \in 1,2,3 \quad (1)$$

I_p represents our main variable of interest, the IAR4Dness index or set of indices (Table 3) and equals zero for the baseline period because IAR4D was introduced after the baseline period. X and Y represent vectors of household and village level control variables identified in Panel B and C of Table 2[19]. $Midline_t$ is a dummy variable and controls for the general trend between two survey periods. We also control for sub-region level changes and shocks that might have happened between baseline and midline periods by using region specific time trends shown by $Z * Midline_t$- equal to 1 in the midline period for corresponding region and 0 otherwise. Finally, we control for the impact of unobserved fixed IP level characteristics on the impact of IAR4Dness and outcome variables, by including IP dummies. We estimate the models with Ordinary Least Squares (OLS) methodology.

We start our analysis by estimating (1) for the overall index. Then, to explore through which principles and factors the impact of the index is driven, we refine our results by estimating (1) for each principles and factor; we estimate a separate model for each principle and factor.[20] Separate estimation of the models prevents the inflation of standard errors in the estimations as some of the IAR4Dness principles are highly correlated (see appendix 5.4 for details). These correlations between the principles result from the definition and the construction of the variables (see section 5.3). If there is any correlation due to an unobserved factor, this is controlled for through the control variables used and through the additional robustness analysis (see below).

5.5.2 Results

The estimation results of model (1) for our main outcome variable are summarized in Panel A of Table 4 and show that FCS levels are higher in the villages where the level of IAR4Dness is higher[21]. The columns refer to the outcome variables, and rows to different IAR4Dness

[19] We do not control for the village characteristic in panel D of Table 2 in model (1) because they were only collected in 28 IPs in baseline surveys. However, our main results are robust to estimating our models for only 28 IPs and controlling for these village level social capital variables.

[20] Our results are robust to the inclusion of the two factor variables in one model.

[21] We test the hypothesis that control variables, time trends and IP level dummies are jointly equals to zero, and we reject the hypothesis for each set of variables and model estimated.

indicators. In Table 4 we only report the estimates for our coefficients of interest: average IAR4Dness, principles and factors. To explore which principles matter most, we repeat model (1) for each principle (see Panel B Table 4). It seems that the relation between IAR4Dness and FSC mainly stems from two IAR4Dness sub principles: non-linear, collective and collaborative interaction (principle 2) and institutional and human capacity building for IP actors (principle 5). These results are in line with the results from Panel C. IPs with active participation in the activities, factor 1, have higher levels of FSC.

Table 4: IAR4Dness and outcome variables

	FCS	**Innovation**	**HH SC**
Panel A: IAR4Dness Index			
IAR4Dness	278.4***	-11.78*	-0.283
	(96.35)	(6.771)	(0.268)
Panel B: IAR4Dness Principles			
Principle1	35.6	-2.436	0.182
	(46.47)	(3.165)	(0.207)
Principle2	120.1*	-6.335	0.0471
	(59.55)	(4.469)	(0.207)
Principle3	98.3	-0.521	0.326
	(159.2)	(2.991)	(0.411)
Principle4	-8.243	-2.133	-0.465**
	(61.74)	(2.627)	(0.226)
Principle5	142.0**	-4.052	-0.151
	(61.08)	(3.008)	(0.175)
Panel C: Factor indicators			
Factor1	18.96***	-0.504	-0.021
	(6.788)	(0.525)	(0.0254)
Factor2	1.181	-0.275	0.0258
	(6.852)	(0.38)	(0.0266)

Note: coefficients of control variables are not included, but

* p<0.10, ** p<0.05, *** p<0.01, Standard errors in parer

To explore the key factors behind our main result we explore the correlation between FSC and the sub indicators of principle 2 and 5. We predict that related sub-components of the indices might be the key factors behind the positive correlation between FSC and the principles. To test whether our conjecture is true, we estimate (1) for four additional specifications. We

replace outcome variable $\mathbf{I_p}$ with the average involvement to listed activities (Principle2a), difference to average participation (Principle2b), average involvement to planning and joint implementation (Principle4a) and average involvement to information sharing activities and field visits (Principle5) (see Table 5).

Table 5: Involvement indicators and calorie intake

	FCS
Principle2a	148.9***
	(50.83)
Principle2b	5.915
	(38.26)
Principle4a	60.01
	(70.8)
Principle5	142.0**
	(61.08)

Note: coefficients of control variables are not included, but available
* p<0.10, ** p<0.05, *** p<0.01
Standard errors in parentheses

The results in Table 5 confirm our conjecture that average participation to the activities is positive and significantly correlated with FCS. Moreover, the type of the activity seems to be key in improving FSC. Participation in information sharing activities and field visits is more important than participation in activities concerning joint planning and implementation as the estimates are bigger and statistically more significant for the former. Finally, equal participation of stakeholders to these activities does not seem to be a critical factor for our results.

5.5.3 Robustness Checks

Our identification strategy rests on the assumption that the level of IAR4Dness is not correlated with IP level unobserved time varying effects that may also influence our outcome variables. In this section, we relax this assumption and test the consistency of our estimates. In Table 6, we report the estimates from alternative models specified to test the robustness of our main results. We focus on the impact of Principle2a and Principle5 on FSC because we found that our results are mainly driven by attendance to the IP activities.

As a first robustness analysis we re-estimate model (1) at IP level. Although the standard errors of our main model is clustered at IP level, household level analysis still might

produce low standard errors, and overstate the significance of our estimates because IAR4Dness is measured at IP level (Wooldridge 2003). For this estimation, we use IP level unweighted average of FCS as the dependent variable, and drop household and village level controls. Column 1 and 2 of Table 6 show that both estimates are statistically significant and robust to our former estimates.

Table 6: Robustness Checks

	IP level		First stage		2SLS	
Variables	**FCS**	**FCS**	**Principle2a**	**Principle5**	**FCS**	**FCS**
Principle 2a	192.515**				642.470*	
	(81.484)				(382.674)	
Principle 5		173.282*				338.591**
		(89.537)				(137.942)
Dummy yearinfield			0.069*	0.130**		
			(0.038)	(0.048)		
R-squared	0.829	0.832	0.992	0.989	0.725	0.011

n=64

* p<0.10, ** p<0.05, *** p<0.01

Standard errors in parentheses

Note: All regressions include IP level fixed effects and country level trend variables. We present estimates for the variables of interest to economize on space.

As a second robustness analysis, we estimate a 2SLS model to isolate the potential impact of unobserved time varying determinants. Unobserved factors such as economic and income shocks that happened after the baseline period may have directly affected both FSC and IAR4Dness. This might create an endogeneity problem for our estimates. To address this concern, we employ the exogenous variation in the duration of field activities of IPs as an instrument (see Panel E in Table 3 for variable descriptions). Some IPs started their field operations later than others due to organisational challenges. Hence, mature IPs had more opportunity to organize IAR4Dness activities. Besides, to our knowledge, the start-ups of IPs were not delayed by to sub-regional shocks. Therefore, our instrument is not directly correlated to food security and satisfies the exclusion restriction, given that we control for IP fixed effect and sub-region level trends.

The specification of 2SLS model employed is as follows. We predict Principle2a (I_p) and Principle5 (I_p) as a function of years of field activity *(D)* of IP *p*, a year dummy (Midline) and a set of region dummies (Z):

$$I_{p,it} = f_{2,p}(D_p,\ Midline_t, Z * Midline_t, IP_{pt}),\ p \in 2a, 5 \quad (2)$$

where ε_{prt}refers to error term and D_p denotes our excluded instrument which equals to 0 in the baseline survey period as there is no field activity and 1 when years of field activities for the corresponding IP is more than 1.5 years (median level)[22] in the midline survey period. Again, we also control for sub-region level changes and shocks that might have happened between baseline and midline periods by using region specific time trends shown by $Z * Midline$- equal to 1 in the midline period for corresponding region and 0 otherwise. We justify the use of the same IV for both principles because they both relate to attendance, and years of field activities should explain both. As our instrument is at IP level, after inserting predicted values for I_{pt} from (2) into (1), we again estimate (1) at IP level for only Principle2a and Principle5

Column 3 and 4 of Table 6 report the first stage estimates for Principle2a and Principle5 respectively. As we hypothesize, a longer period of field activities enhance the average involvement to listed activities and information sharing activities and field visits even though the relationship for the former is less is powerful. Finally, column 5 and 6 present the 2SLS estimates for Principle2a and Principle5. The estimates are positive and statistically significant. Hence, they confirm our estimates are consistent with our main findings when we isolate the impact of unobserved time varying factors using years of field activities as an instrument.

5.6 Discussion

The findings above point out that IPs in which average involvement to the activities is higher are more successful in increasing food security. In this section we estimate a simple linear regression models to explore whether involvement related indicators are related to IP level[23]

[22] We also test the robustness of our estimates by using years of field experiments as an instrument instead of dummy variable. The first stage estimates for Principle 2a as well as second stage estimates are not statistically significant while our results for Principle5 are still robust.

[23] The IP level characteristics are calculated by taking unweighted average of the characteristics at IP level.

baseline household characteristics, village amenities and village social capital measures listed in Table 2. As the numbers of observations at IP level are few, degrees of freedom in the estimations are not enough to reliably estimate coefficients for all characteristics at the same time. Therefore we separately estimate each coefficient and only control for baseline IP level FCS.

Results in Table 7 provide some tentative evidence that the level of involvement in IP activities is related to baseline village characteristics of the regions where IPs are established. Controlling for baseline level of FSC, involvement of IP stakeholders is higher in communities with higher levels of education, higher percentage of female headed households, and higher levels of village social capital in terms of trust and gift exchange. Although not statistically significant (p-value=0.11), extent of settling conflicts in the village is also positively correlated with the level of participation to information sharing events. There is no statistically significant correlation between involvement indicators and village amenities – the proxies for the quality of infrastructure in the villages. This may imply that the initial development level of the villages do not play a role in the successful implementation of the project.[24]

[24] Because our number of observations is limited, standard errors are generally high and imprecise, and we are vulnerable to type II errors: to falsely conclude that there is no effect, even if there actually is one.

Table 7: Involvement to IP activities and baseline characteristics, controlling for FSC

	Principle2a		Principle5	
	coef.	se	coef.	se.
Panel A: Household characteristics				
Gender	-0.094	(0.065)	-0.174**	(0.074)
Headage	-0.007	(0.005)	-0.005	(0.006)
Headed	0.035*	(0.019)	0.036	(0.024)
HHsize	-0.096	(0.089)	-0.076	(0.121)
Panel b: Village characteristics				
School	0.007	(0.076)	0.044	(0.087)
Hospital	0.074	(0.082)	0.094	(0.098)
Worship	0.014	(0.075)	0.034	(0.079)
Socialhall	-0.012	(0.052)	-0.035	(0.059)
Roads	-0.103	(0.081)	-0.119	(0.092)
Mobilenetwork	-0.145	(0.131)	-0.081	(0.164)
Panel C: Village social capital variables				
Participation	0.009	(0.032)	0.032	(0.037)
Trust	0.050	(0.034)	0.071*	(0.04)
Cooperation	0.043	(0.03)	0.047	(0.032)
Gift exchange	0.046	(0.031)	0.069*	(0.035)
Contrcomm	-0.003	(0.027)	0.018	(0.028)
Contributgr	0.000	(0.027)	0.026	(0.03)
Helping	-0.001	(0.027)	0.015	(0.03)
Conflicts	0.030	(0.028)	0.057	(0.034)
Norms	-0.031	(0.025)	-0.026	(0.029)
Womenconfid	0.024	(0.04)	0.022	(0.048)
Consdwomen	0.021	(0.04)	0.059	(0.043)

n=32 and 28 for Panel C variables
* p<0.10, ** p<0.05, *** p<0.01
Standard errors in parentheses

5.7 Conclusion

There is considerable heterogeneity in impact of the innovation system approach on resource poor farmers at IP level. In this paper we argued this may be because there is heterogeneity in implementation: IPs may not have equally implemented the principles of the IAR4D approach. We explore heterogeneity in implementation, and the effect thereof, by quantifying the five defining principles of IAR4D into an IAR4Dness index and linking these to the main survey data. We find that the IAR4Dness index is correlated positively and significantly to FCS, our proxy for calorie intake.

This relation between IAR4Dness and FSC mainly stems from two IAR4D sub principles: non-linear, collective and collaborative interaction (principle 2) and institutional and human capacity building for IP actors (principle 5). Looking at the sub-components of these principles, especially participation in information sharing activities and field visits is crucial. Success of IPs thus seems to depend on the attendance and contributions of stakeholders to the activities of the IPs. More specially, we believe this result may indicate that IPs only become beneficial for villagers when they (and other IP stakeholders) participate in capacity building events such as field visits and information sharing activities. Recent case study evidence from improved maize legume and production systems in Nigeria support our findings, and explain how capacity building activities help the platform perform. Dangbegnin et al. (2011) state that the platform organised capacity building activities on IAR4D and team building to enhance interdisciplinary, problem solving, team working and learning skills of platform members. They argue that these activities "enabled platform members to work as equal partners" (p. 92).

It is also interesting to note that other IAR4Dness (sub) indicators of IAR4D do not seem to matter in terms of impact on FSC. For example, the different types of stakeholders involved or equal participation of these stakeholders to activities. Apparently average participation is more important than diversity per se. In fact it is easy to imagine some sort of trade-off between the number of stakeholders involved in an IP and the average participation of these stakeholders. This was supported by our factor analysis. It could well be that this means that IPs with less diverse partnerships, but overall higher average participation because of this, are more successful than IPs with many additional but low participating partners. Perhaps it becomes more difficult to manage the IP as it becomes bigger: i.e. it might be harder to align different goals and objectives and coordinate the IP.

We also find that the effect of IAR4Dness on FSC does not operate through increased use of agricultural technologies or increased levels of household social capital. However, we only investigate two potential channels through which IPs can boost FCS. There are many other potential channels such as integration to markets or access to finance. There is need for future research to shed light on these channels.

A follow up question would be to identify which factors promote active participation of IP stakeholders. Tentative results suggest that involvement of IP stakeholders is higher in communities with higher level of education, higher percentage of female headed households, and higher levels of village social capital in terms of trust and gift exchange. The potentially

important role of these types of social capital is also supported by Nederlof et al. (2011) who conclude that trust, commitment and ownership were critical success factor in the 12 case studies they investigated.

Finally, we note two methodological issues regarding our results. First of all, we show that researchers can investigate the heterogeneity in the implementation of a project and the performance of the project partners by applying an objective survey to the partners after the treatment. However, we are aware of the fact that our IAR4Dness measures might be subject to measurement errors as we utilize a set of objective questions directed to platform members after two to three years implementation of the project. To minimize the error, a better approach might be collecting data from all stakeholders through a consistent monitoring and evaluation (M&E) survey during implementation. Secondly, we use data from baseline and midline surveys conducted merely two to three years after the platforms are established. This means that our results reflect only the short-term effects of IAR4Dness from early maturing platforms. An end-line survey is scheduled for late 2013/early 2014. By using the new data set from matured platforms, follow up research should probe the robustness and sustainability of the preliminary results presented here.

5.8 Appendix

Appendix 5.1: Project learning sites, countries, implementing agents and IPs

West Africa (KKM): Niger and Nigeria

- INRAN: IPs related to livestock-feed, millet-cowpea, vegetables, and groundnut.
- IFDC: IPs related to livestock-feed, maize-legume-livestock, vegetables, and rice
- IITA: IP related to maize-cowpea-livestock, and 2 related to sorghum-cowpea-livestock

East Africa (LK): DRC, Rwanda and Uganda

- CIAT: IPs related to banana, Irish potatoes, beans and cassava
- ISAR: IPs related to NRM, livestock, milk, seed potato and maize
- Makerere/ICRISAT: IPs related to potato, soil and water conservation, pineapple and sorghum

Southern Africa (ZMM): Zimbabwe, Malawi, Mozambique

- CIAT: IPs related to conservation agriculture
- Bioversity International: IPs related to horticulture

Appendix 5.2: Characterization of IAR4D as implemented by FARA

Please note this is a modified version of the actual 2.5 page survey. All data collected is listed, but to economize space, the structure has been revised. The text in italic between brackets refers to pre-defined answer categories.

Identification IP

Name of the organisation; Name of the Innovation Platform (IP); Country of the IP; District of the IP; Sub country/other of the IP; When was the IP formed (month and year).

Identification respondent

Your Name; E-mail address; Your position in the organisation; Your role in the IP.

IP formation and functioning

How did the IP originate? (*from scratch*, *builds on existing networks*, *already fully existed)*

How is the IP facilitated? (*researchers, by local stakeholders*, *jointly)*

How are participants selected for the IP?

IP participation of stakeholder

Which of these stakeholders are represented in the IP? *(yes, no - see footnote 16 for list of stakeholder)*

How often (approximately) do the following partners in your IP conduct or attend a) joint planning of activities; b) joint implementation of activities; c) information sharing; d) field visits or workshops; e) seminars and training events? (*daily, weekly, monthly, every six month, every year or less)*

Problems addressed

Is the problem area addressed in IP? *(yes, no)* a) low agricultural technology use; b) access to inputs; c) market access and strategy problems; d) land related problems; e) other.

Who identified the problem *(list of stakeholders in footnote 16)*

Was the problem prioritized *(yes, no)*

Was an action implemented *(yes, no)*

Who designed the policy *(list of stakeholders in footnote 16)*

What is the action?

Appendix 5.3: Factor analysis IAR4Dness indices (n=32)

Variable	Factor1	Factor2
Principle 1		0.9428
Principle 2a	0.993	
Principle 2b		0.968
Principle 3a	-0.512	
Principle 3b*		
Principle 4a	0.831	
Principle 4b		-0.438
Principle 5	0.927	

Note: blank spaces are loadings < .4

*excluded because the same (1) for all IPs

Appendix 5.4: Correlation coefficient estimates for IAR4Dness index and principles (n=32)

	Index	P1	P2	P3	P4	P5
IAR4Dness	1					
P1	0.65*	1				
P2	0.85*	0.91*	1			
P3	-0.40*	-0.41*	-0.55	1		
P4	0.52*	-0.17	0.07	-0.15	1	
P5	0.80*	0.36*	0.66*	-0.6	0.41*	1

* significant < 10 percent level

Chapter 6 Opening the black box of Social Capital: trust and group membership in the Lake Kivu Region

Abstract: Central to this paper is the debate on how social capital is conceptualised and measured. Part of the critique relates to the ambiguous relationship between different indicators of two major components often used to represent social capital: trust and membership in formal or informal groups. It is unclear to which extent these components can be represented by a single indicator or how the two constructs are related to each other. In this paper, we analyse an extensive set of social capital indicators in the border region of the Democratic Republic of Congo, Rwanda and Uganda using factor analysis and path analysis. We present three main results. First, trust and membership in different groups cannot be captured by a latent factor called social capital. Second, different forms of trust are generally positively correlated to each other, but cannot be captured by one latent factor. Third, group membership - of any type - cannot be expected to automatically translate in or be associated with higher levels of trust. In the Lake Kivu region participation in only three out of thirteen groups is positively and significantly associated to trust in different societal groups.

Paper by Fédes van Rijn, Domenico Dentoni, Stefano Pascucci and Judith Oduol.

6.1 Introduction

Social capital, generally described by the characteristics of social networks, is used to explain a wide range of phenomena from families and youth behaviour problems to democracy and governance (Woolcock 2010). The development and institutional economics literature reports that a high level of social capital has a positive impact on economic development (Knack and Keefer 1997; Narayan and Pritchett 1999; Zak and Knack 2001; Fafchamps and Minten 2002; Grootaert and Bastelaer 2002; Isham 2002; Karlan 2005; Ahlerup et al. 2009; Baliamoune-Lutz and Mavrotas 2009). Yet, how the different components of social capital are interlinked and how they impact socio-economic development is not sufficiently explored. The different conceptualizations and measures of social capital used in the literature make it challenging to address this.

Woolcock (2010) argues that the use of different conceptualizations and measures of social capital might be inherent to the concept and we should not aim for a common definition. He refers to the term "essentially contested concepts" from Gallie (1956) to emphasize that the utility of social capital lies in facilitating constructive discussion on the importance of social relationships, rather than in forging consensus on how it is defined exactly. However, the use of different indicators by different studies make it difficult to compare results and implications. Therefore, it is not surprising that the discussion on measurement of social capital is still on-going (Rupasingha et al. 2006; Sabatini 2009; Guiso et al. 2010).

Part of this debate relates to the measurement of two key components of social capital: trust and group membership (Poder 2011). Trust is often one of the intended (side) effects of increased group participation and at the same time might be a pre-condition for those groups to form. Group membership is often the more tangible part of social capital targeted by policy makers to foster cooperation between people. Examples are community driven development projects that aim to enhance a range of development outcomes or strengthen civil society in general (Mansuri and Rao 2004). It is unclear to what extent trust and group membership can be represented by specific indicators, to what extent these indicators actually represent the same social capital construct and how the two are related. Although this is conceptually well known, there is little empirical analysis highlighting this. It is also unclear to what extent these indicators of trust and group membership are related to each other (e.g. Claibourn and Martin 2000; Quibria 2003). Despite this, specific indicators of trust

and group membership are often used to generalize results and implications of social capital related research.

The objective of this paper is twofold. First, we test the hypothesis that the indicators of trust and group membership can be summarised in one latent factor called "social capital". We also formulate a more specific hypothesis that our trust indicators can be summarised in one latent factor. The second objective is exploratory, namely to investigate the relationship between the individual indicators of trust and group membership. We distinguish trust in people inside the village, outside the village, strangers, local and central government officials, research institutes, traders and NGOs. We also distinguish between membership in community, agricultural, cultural, welfare, financial and political groups. All variables were measured at the individual level.

To meet these objectives, we used data collected the Lake Kivu (LK) of the Sub Saharan African Challenge Program. LK covers the border region between the Democratic Republic of Congo (DRC), Rwanda and Uganda. To understand the interrelations between different components and indicators of social capital is particularly relevant in a context of "weak institutions" where legal systems are unable to protect private property rights and major socio-economic shocks, such as civil war and violence, affected local communities intensively (Hyden 2001; Voors et al. 2012).

We present two main results. First, trust and membership in different groups cannot be empirically reflected by one underlying social capital factor. Likewise, different forms of trust, even though generally positively correlated to each other, cannot be captured by one latent trust factor. Second, group membership - of any type - cannot be expected to automatically translate in or be associated with higher levels of trust. Participation in only three out of thirteen groups is positively and significantly associated with trust in different societal groups. These results confirm concerns raised by various authors including Sabatini (2005), Poder (2011) and Quibria (2003) related to the inclusion and interpretation of social capital indicators in empirical models. Moreover, these results have implications for programmes aiming to enhance development by promoting cooperation in groups, trust and norms of behaviour towards mutual beneficial action. These programmes should consider which component of social capital they try to influence, what type of effects this may have on other components of social capital, and to which extent other components of social capital are essential for success.

In Section 6.2, we discuss the conceptual framework, including a discussion on trust, group membership and the relationship between the two. In Section 6.3, we summarise and describe the data. In Section 6.4, we describe the method we used to estimate the correlation within and between the two social capital components. In Section 6.5, we discuss the outcomes of these models, including several tests of robustness. Section 6.6 concludes.

6.2 Conceptual framework

6.2.1 Social capital

In this study we focus on two important and well-known components of social capital namely trust and group membership (see chapter 2.2 and 2.5). These two components fit well within the conceptual separation between cognitive and structural social capital (Uphoff and Wijayaratna 2000). Trust is one of the major representations of cognitive social capital and group membership is one of the major representations of structural social capital. Trust can be classified according to personalised trust, generalised trust and institutional trust (Groenewald and Bulte 2012). Personalised trust refers to trust in existing networks; generalised trust refers to trust in strangers; and institutional trust refers to trust in more formal governance networks. Group membership, or networks more generally, can be further separated based on whether they are bonding (ties to similar people), bridging (ties to other groups of people) or linking (ties to more formal institutions). Usually networks are classified according to this distinction although in reality a network can be bonding, bridging and linking at the same time depending on its members and activities (Bhandari and Yasunobu 2009).

6.2.2 The relationship between trust and group membership

In the literature the relationship between trust and group membership depends on at least four factors. The first factor is the level of involvement in groups (Wollebæk and Selle 2003); the intensity of participation may strengthen any effect between membership and trust. The second factor is the scope of involvement (Wollebæk and Selle 2003); multiple affiliations mean more and broader interaction which could result in spill over effects to other groups. The third factor is the institutional environment in which people are embedded. The institutional environment is the set of formal and informal political, social and legal rules of cooperation (Ahlerup et al. 2009). It also includes the potential influence of various specific micro factors such as the trustworthiness of local leaders. Finally, the relationship between trust and group membership may depend on the type of trust and group membership (Wollebæk and Selle 2003). For example, strong bonding networks (such as religious groups)

may be correlated with higher levels of trust within that group, but lower levels outside the group (generalized or institutional trust). The reverse could be true for participation in agricultural groups that are oriented more to the outside of the village.

Many authors implicitly or explicitly assume group membership results in more trust (e.g. Putnam 2000). Although the mechanism through which this effect is assumed to take place differs, it generally follows the argumentation that participation in networks, and this can be any kind of network, allows trust to spread outside your existing network (Wollebæk and Selle 2003). Examples of such effects are abundant; a producer who joins a cooperative that purchases farm inputs collectively will get to know more people inside his village, and possibly outside the village, with whom he can build a relationship of trust.

However, the relationship between trust and group membership is not clear-cut. Negative experiences with groups may actually decrease existing levels of trust (Claibourn and Martin 2000). A classic example is the embezzlement of funds by cooperative officials before the introduction of the structural adjustment programs in SSA. Moreover, membership in certain groups may enhance trust inside the group but just as easily create mistrust outside this group (Kumlin and Rothstein 2005). It is therefore not necessarily true that group membership results in higher levels of trust. Moreover, some argue that trust is actually a necessary foundation for the formation of groups or networks (e.g. Dasgupta 2005). Those who have more trust towards others are more likely to become active in networks (Sabatini 2009). If the farmer in the example has a lot of trust in his fellow-farmers, he may be more inclined to cooperate with them in the first place. This is probably because the costs of cooperation are lower. But again, we can argue the other way around as well; distrust and lack of trust can motivate people to cooperate (Cook et al. 2007). If a farmer has low levels of trust towards his fellow farmers, there is a larger need to create a more formalised group if he wants to purchase inputs collectively. The benefits of cooperation are higher.

6.2.3 Research hypothesis

Based on the discussion in section 6.2.1, we formulate the hypothesis that we expect different components of social capital to be empirically reflected in one social capital factor. However, group membership in one group might exclude group membership in another because of time constraints or conflicting interests. For trust this is not apparent. Therefore, we formulate a second, more accurate, hypothesis that our trust indicators can be summarised in one trust factor.

In the second part of this conceptual framework we highlighted that it is unclear whether trust and group membership are necessarily related, how they are related (positive or negative) and what the causality of the relationship is. Considering the data at hand, we focus on the first two questions and leave the causality question for future research. Because this part of the research is exploratory in nature, we do not formulate any specific hypothesis at this stage. However, we do anticipate finding some coherence in the relationship between the specific types of trust and specific types of groups. For example, it is quite intuitive that trust in people within the village is related to membership in community-oriented groups (i.e. village community and civic group) and social/cultural groups (i.e. burial, religious and sport clubs). Another example would be that trust in local and national government and NGOs is related to membership in political and social/cultural groups.

6.3 Data

6.3.1 Sample

To empirically explore the relationship between trust and group membership we used the data collected by the Sub-Saharan African Challenge Program. The program was implemented by the Forum of Agricultural Research in Africa (FARA) and adopted the Integrated Agricultural Research for Development approach (IAR4D) as its main approach in eight African countries. Innovation Platforms, which can be described as an informal coalition and alliance of conventional agricultural research and development actors, are at the core of this approach. This study focuses on the border area between the DRC, Rwanda, and Uganda, referred to as the Lake Kivu region in the remainder of this paper.

Our data is drawn from a household survey conducted in 2010 among 2239 household heads or another adult representing the household. The main purpose of this data collection was to evaluate the IAR4D approach and compare its outcomes to that of conventional agricultural research and development. Therefore, the programme implementation and data collection was part of a large scale pilot experiment (FARA 2009). A baseline survey was also conducted between mid-2008 and mid-2009. We used data from the second round of surveys collected in mid-2010 because it included a more extensive measurement of trust and group membership. After a careful selection of villages corresponding to the objective to evaluate the programs impact (see chapter 4), ten households were randomly selected from a total of 242 villages.

6.3.2 Trust

Trust, the first component of social capital, was measured based on two types of survey questions. First, we used the well-known World Value Survey question: "Generally speaking, would you say most people can be trusted?" This question was answered by yes or no. However, there has been critique on this question because it is unclear what is understood by "most people" (e.g. Glaeser et al. 2000). Moreover, one of the interests of this paper was to explore to which extent the relationship between group membership and trust depends on the type of trust or group. Therefore, we also measured more specific types of trust in the form of "In general, how would you describe your trust in the following people?" from the World Bank Social Capital Group Survey (Grootaert et al. 2004). The types of trust identified in the survey were based on a discussion with the implementing partners and essentially refer to different societal- or reference groups. These indicators reflect the respondents' levels of trust and were measured on a 1 to 5 scale, where a score of 1 means "very poor" and a score of 5 means "very good". Table 1 shows descriptive data and the categorization according to the types of trust as discussed in section 6.2.1.

Table 1: Descriptive data on trust (n=2239)

Trust	Type	Level of trust				
		very poor	poor	good	good	very good
Within the village	Personalised	12%	11%	36%	34%	7%
Outside the village	Generalised	18%	17%	45%	19%	1%
Strangers	Generalised	35%	29%	29%	6%	0%
Local government	Institutional	15%	14%	33%	30%	7%
Central government	Institutional	18%	18%	33%	23%	8%
Agricultural traders	Institutional	21%	31%	35%	13%	1%
Research institutes	Institutional	26%	18%	34%	17%	4%
NGOs	Institutional	21%	16%	41%	18%	4%

As expected, the evaluation of trust depends on the type of trust. The evaluation of the specific indicators of trust does not show an optimistic picture because more respondents indicate that trust is very poor or poor rather than very good or good. This is true for all types of trust, except for trust within the village and trust in local government officials. Trust inside the village is usually evaluated as the highest or single highest, whereas trust in strangers is evaluated very poorly. Contrary to this, 64% of the respondents indicate they, generally speaking, think other people can be trusted.

6.3.3 Group membership

Group membership, the second component of social capital, was defined based on the participation of the respondent in an almost inclusive list of formal and informal groups[25]. In Table 2 we present the descriptive data, including a column identifying the focus of the group; agriculture, community development, politics, finance, welfare or social/cultural issues.

Table 2: Descriptive data group membership (n=2239)

Group membership	Type	Membership
Marketing	Agriculture	3%
Production	Agriculture	18%
Processing	Agriculture	1%
Village committee	Community	33%
Village civic	Community	10%
Political	Political	33%
Water and waste	Community	7%
Finance or saving	Financial	34%
Health	Welfare	18%
Education	Welfare	8%
Burial or festival	Social/cultural	36%
Religious	Social/cultural	62%
Cultural	Social/cultural	9%
Sports	Social/cultural	7%

Table 2 shows quite some variation in membership across the different groups. Most respondents participate in religious groups followed by burial and festival societies, credit groups, political groups and village committees. Very few households participate in processing groups, marketing groups, water and waste management groups, sports groups, education groups and cultural groups. It is interesting to note that the two most common groups are socially oriented, whereas the least common are agriculturally oriented.

[25] In the survey groups were defined as "groups, organisations, networks or association can be formally organised groups or just groups of people who get together regularly to do an activity or talk about things"

6.4 Empirical strategy

6.4.1 Main estimation strategy

Data were analysed with Structural Equation Modelling (SEM). SEM allows us to examine the series of interrelated relationships between the social capital indicators and latent constructs and, if applicable, among the latent constructs (Hair et al. 2010). In this study, these latent constructs are social capital and trust. We pool the data of the three countries together in one data set. Interpreting results in light of the (different) institutional settings is left for future research. SEM combines a set of measurement and multiple regression models in a system of equations. The method involves a two-step procedure (for details see Kaplan 2009; Hair et al. 2010).

The first step is identifying the latent constructs through Factor Analysis (FA). This step corresponds to the confirmatory objective of this paper, namely testing the two hypotheses as outlined in section 6.2.3. We used exploratory FA to identify which indicators can be reflected by which latent factors. The factors are based on the interrelations between the indicators and the number of factors on the variance extracted within each factor[26]. We used confirmatory FA to test these factors based on two common goodness-of-fit indices: the Root Mean Square error of Approximation (RMSEA) and the Comparative Fit Index (CFI)[27].

As a second step, we identify and test the entire set of direct and indirect relationships among our indicators and/or constructs using a trial-and-error procedure based on the overall goodness-of-fit with the data. This step corresponds to the exploratory objective of the paper as outlined in section 6.2.3. Similar to the confirmatory FA, goodness-of-fit was evaluated based on CFI and RMSEA.

[26] According to the Kaiser criterion, only factors with an eigenvalue > 1 are retained. Through the varimax method, the variance of factors across variables is maximized (Kaplan 2008).

[27] The RMSEA is an absolute fit index and takes into account sample size and model complexity in its computation. Lower values of the RMSEA indicate better model fit with values below 0.10 being acceptable; below 0.05 being good; and below 0.01 being very good (Kaplan 2008). The CFI is an incremental fit index comparing the estimated model to a model in which no correlation is assumed. The range of the CFI lies between 0 and 1, with higher values indicating better model fit. Usually levels above 0.9 are considered acceptable (Hair 2012). Empirical evidence indicates that RMSEA is more appropriate in case of large sample sizes (Rigdon 1996; Hair, et al 2010)

Given the current gap in the literature on the relationship between trust and group membership, we took an exploratory approach of model building (Hair et al. 2010). Therefore, analysis was data-driven rather than theory-driven (see for example Cudeck and Henly 1991, Maccullum, Tucker and Briggs 2001 cited in Bentler 2006). At the start of the analysis, the relationships among variables were identified based on Pearson's correlation coefficients, which are widely used to measure of the strength of correlation between pairs of variables. On the basis of the Pearson's correlation matrices among variables we identified these paths in three steps: 1) within the set of trust indicators, 2) within the set of group membership indicators and 3) across trust and group membership. Paths were included if statistically significant at less than 5% and higher than 0.50, 0.30 or 0.15, depending on the strength of correlations in the data. The Lagrange Multiplier (*LM*) and the Wald Test (*W*) were used to find a model with higher goodness-of-fit[28]. Both measures can be interpreted as goodness-of-fit tests of the revised model compared to the starting model (Bentler 2006). It is important to note that our model does not test cause-and-effect relationships, but merely explores relationship between the variables. The assumptions made on which variables are dependent or independent variables in the model should be interpreted as proposed interpretation of cause-effect relationship that future research could address.

6.4.2 Country, village, and household variation

We re-estimate the final model at country level using a so-called multi-group SEM to test whether the final path model varied across the three countries. As was noted before social capital is recognized as a highly contextual construct (e.g. Mansuri and Rao 2004). The Lake Kivu region was initially chosen because the countries emerged from conflict at different times, resulting in different national policies, institutions and physical infrastructures (Bekunda et al. 2005 from Farrow et al. 2011) . This may influence the level of trust and group membership and the relationships between them. We compared the model fit statistics and the size, sign and significance of each country path with the results of the pooled sample.

Besides country differences, differences at a lower level of administration might also influence the relationship between our indicators of social capital. Therefore, we investigate

[28] In deciding on the number of parameters to add we used Hancock's finite intersection multiple comparison rationale (Bentler 2006). This allows a conservative testing strategy by taking into account the degrees of freedom of the current model instead of the usual one degree of freedom.

whether our results are robust to different village and household characteristics (see appendix 6.1).

We estimate each of the 23 social capital indicators (Y), being a specific level of trust or group membership for household *i*, as a function of the other indicators of trust (T), the other indicators of group membership (G), the set of household control variables (X) and village control variables for village *j* (Z):

$$Y_{n,i} = f_{1,n}(T_i, G_i, X_i, Z_j), \quad n \in 1,2,3...23 \tag{1}$$

To prevent potential impact of the IAR4D approach from influencing these household characteristics we use the 2008 baseline data for X and Z. We use simple Ordinary Least Squares methodology because, even though this method does not estimate the equations as a system, it more easily accommodates the amount of control variables we want to include.

6.5 Results

6.5.1 Social capital factor

Before we test the hypothesis that trust and group membership can be empirically reflected in one latent factor, we explore the relationship between our indicators using a simple correlation matrix (see appendix 6.2). Membership in all types of groups is significantly correlated to membership in various other groups. However, the size of the correlation coefficients is not very high and some correlation coefficients are negative. Only about half of the correlation coefficient between group membership and trust are significant at $p>0.05$. The majority of the significant correlation coefficients are positive; higher levels of trust are associated with higher levels of group membership. The other indicators of trust and group membership are not significantly correlated. Contrary to this, we find that the correlation matrix shows large positive and significant correlations among all trust variables, except for general trust (appendix 6.2b). The relationship between different indicators of social capital is therefore not at all clear.

The results from the exploratory FA in Table 3 confirm our preliminary observations that social capital cannot be empirically reflected by one latent factor. The FA results in a set of seven very scattered factors. As expected, the confirmatory FA thus rejects the hypothesis that different indicators of trust and group membership are reflected by the common underlying factor of social capital (CFI: $0.55<0.90$ RMSEA; $0.11>0.10$).

Nevertheless, the trust indicators in Table 3 are clearly concentrated in the first two factors. Loadings for factor 1 are high for all trust indicators, except for general trust. Loadings

are particularly high (>0.70) for trust in government officials, research institutes and NGOs. All these loadings are higher than their loadings for factor 2. This is also true for trust in traders. These results are in line with the theoretical construct of institutional trust as often used in the existing literature on social capital and trust discussed in section 6.2.1. General trust, trust inside and outside the village and strangers all score high for factor 2 (>0.52) and higher than on factor 1. Therefore this factor captures a combination of personalized and generalized trust. Some indicators load almost the same for both factors (trust in stranger and trust in traders) and some indicators loading high on one factor still load relatively high on the other (trust inside the village, trust in local and central government officials).

Table 3: Exploratory factor analysis social capital (n=2239)

		Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
group membership	Marketing						0.77	
	Production							0.81
	Processing							0.39
	Village committee						0.49	
	Village civic			0.37			0.57	
	Political					0.70		
	Water and waste			0.65				
	Credit				0.65			
	Health					0.67		
	Education			0.68				
	Burial or festival				0.82			
	Religious		0.37		-0.49	0.41		
	Cultural			0.67				
	Sports			0.72				
Trust	General trust		0.52					0.38
	Within the village		0.66					
	Outside the village	0.39	0.73					
	Strangers	0.35	0.60					
	Local government	0.70	0.40					
	Central government	0.78						
	Agricultural traders	0.45	0.36			-0.39		
	Research institutes	0.84						
	NGOs	0.79						

Note: only factor loading above 0.3 or below -0.3 are shown

Corresponding to our second hypothesis we perform a confirmatory FA to test if trust in different groups of people is correlated highly and consistently enough to be captured by one latent factor. Based on the discussion of the factor analysis, it is not surprising this hypothesis is rejected (CFI: 0.79<0.90 RMSEA; 0.17>0.10) . Therefore, we also performed a confirmatory FA to test the hypothesis that the set of trust indicators represent two underlying constructs, namely institutional trust and generalised/personalised trust. Both goodness-of-fit-statistics reject the hypothesis (CFI: 0.86<0.90 RMSEA; 0.14>0.10). This means that even though the trust indicators are closely related, the closeness is not strong enough to argue they can be captured by the two underlying factors. Therefore, we reject both hypotheses and conclude that our social capital indicators are more effectively represented as individual indicators.

6.5.2 Relationships among trust and membership in groups

The first step in our path analysis explores relationships among the indicators of trust in different groups. The initial path model included all significant Pearson's correlations above 0.5 in appendix 6.2. We built the model with trust at lower levels of institutions as independent variables and trust at higher levels of institutions as dependent variables, although this does not imply causality but only relationship (Kaplan 2009; Hair et al. 2010). After testing a set of models according to the described trial-and-error procedure, the final model, for which all parameters are significant at less than 5%, is presented in Figure 1. To arrive at this model we added three relations to the starting model: between trust inside the village and trust in local government officials, agricultural traders and general trust (see dashed lines). The model fit is acceptable with an RMSEA of 0.09 and a CFI of 0.95. This means that our model of interrelations as depicted in figure 1 adequately captures the interrelatedness in our data.

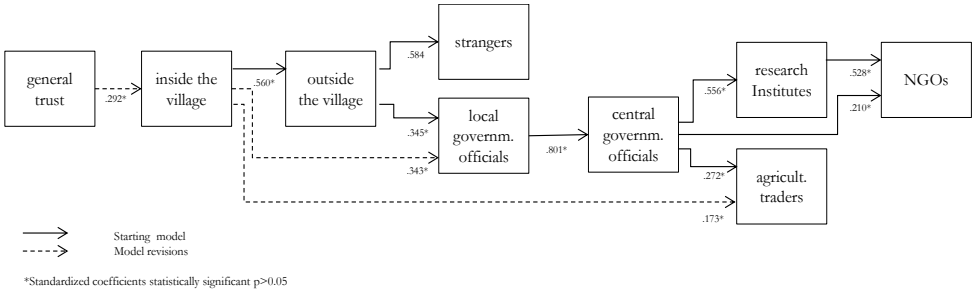


Figure 1: Path Model Trust

Figure 1 confirms that different types of are significantly related with coefficients ranging from 0.173 between trust inside the village and trust in agricultural traders till 0.801 between trust in local government officials and central government officials. Therefore, observing high levels for one type of trust would therefore generally be associated with high levels in other types of trust. More specifically, general trust is related to trust inside the village. Apparently evaluation of general trust most closely corresponds to evaluation of trust in those people nearby. Trust inside the village is closely related to trust outside the village, and to trust in local government officials and trust in agricultural traders. This could be because part of the local government officials and agricultural traders may in fact be from the same village, or are very familiar with people inside the village. Trust outside the village is also related to trust in local government officials and is the only parameter in explaining trust in strangers. Trust in local government officials is the only explanatory parameter in trust in central government officials, but with a very high coefficient. Trust in central government officials appears to be central for trust at higher levels, being related to trust in NGOs, trust in agricultural traders and trust in research institutes. Finally, trust in NGO's is related to trust in research institutes.

The second step of the path analysis process involved testing relationships among membership in the different groups. Because none of the correlations in our data is above 0.5 (see appendix 6.2), the initial path model was built with variables having correlations above 0.3. We tested two initial models. In the first model the paths generally run from membership in community and welfare oriented groups to membership in socio-cultural groups (see Table 2 for classification). The reverse is true for the second model. Based on the described trial-and-error procedure, the final model is given in Figure 2. To arrive at this model we added several relations between village committees and village civic groups and other groups. The model fit is the highest for the first model, with an RMSEA of 0.053 and a CFI of 0.950 (see Table A6).

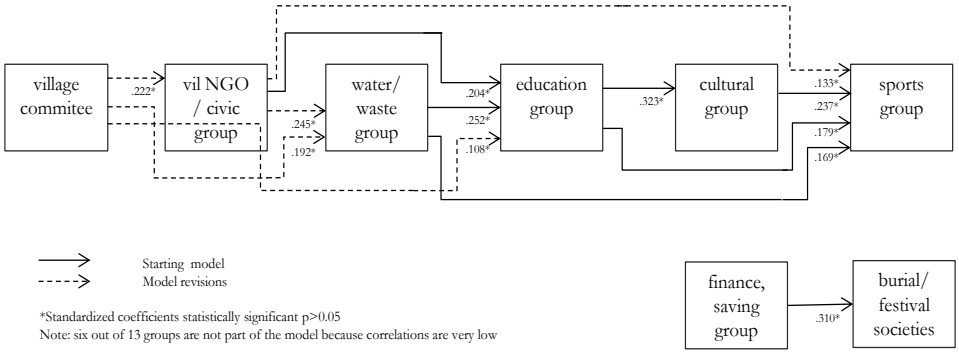


Figure 2: Path Model Group Membership

Contrary to the path model for trust we found that membership in different groups is not necessarily related to membership in other groups, not in positive nor negative terms. Membership in five out of thirteen groups is not related to membership in any other group; groups related to agriculture (marketing, production, processing), politics, or health. Please note that these groups are not depicted in the figure. This is surprising because membership in one group may make it too time consuming, unnecessary or even impossible for someone to join another group. In this case one would expect a significant negative relation.

Those indicators of group membership that are related are always positively related; membership in one group is usually associated with more participation in other groups. Coefficients range from 0.108 between membership in village committees and education groups till 0.310 between membership in finance groups and burial or festival societies.

There appear to be two clusters in the figure that link the different types of groups as identified in Table 2. The first cluster links membership in the three community groups to one welfare and two socio-cultural groups. Apparently, membership in village committees plays a central role because this is associated to membership in three other groups. Moreover, it is the only variable associated to membership in village civic groups, which in its turn is related to those same groups as well as membership in cultural groups. The fact that membership in village committees is quite high relative to the other groups in this cluster could be an explanation for this central role (see Table 2). Another reason could be that, considering the community purpose of village committees, people with different backgrounds and interests in joining group are represented. The second cluster associates membership in finance groups to

membership in burial and festival societies. These two groups may co-exist for the purpose of providing safety nets and performing important functions such as substituting the formal insurance systems that are often out of reach for the rural population. Burial and festive groups, just like finance groups, often save money to rely on in case a group member is for example bereaved or gets married.

The final step of the path analysis procedure was to test the overall model analysing relationships among different types of trust and group membership. We start our model by joining the final trust and group membership model in one estimation. Because many correlation coefficients are either not significant or very low, we also tested relationships among variables that were significantly correlated with an absolute value above >0.15 with the described trial-and-error procedure. The final model has an acceptable fit (RMSEA: 0.056, CFI: 0.911) and has various trust measures related to membership in political groups, burial and festival societies and finance groups.

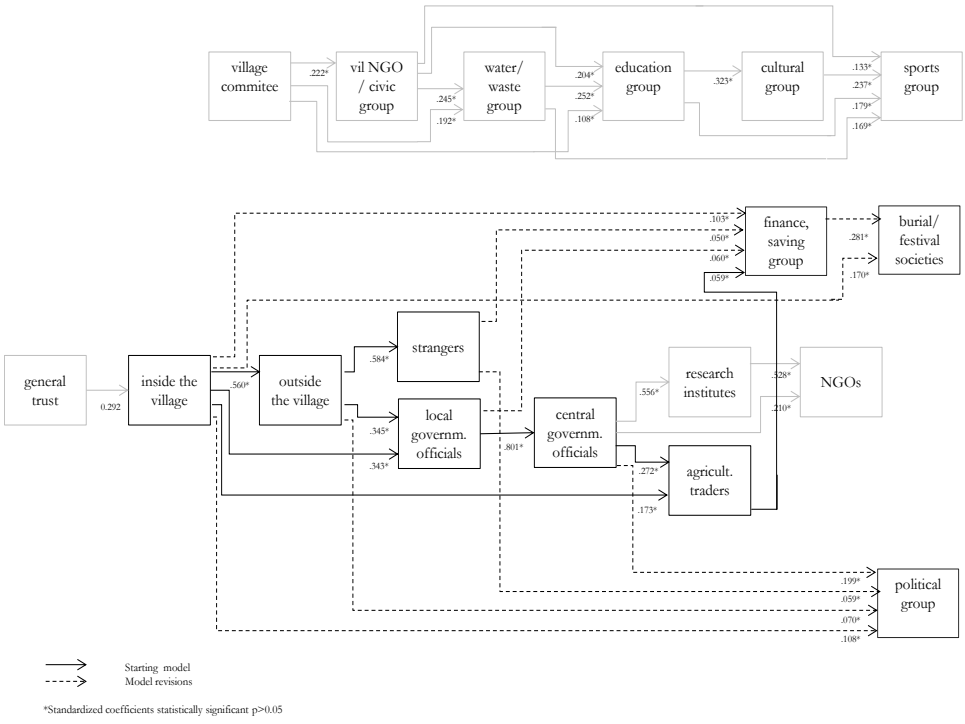


Figure 3: Path model group membership and trust

Based on the results of the path analysis (Figure 3), it is evident that the correlation between membership in various groups and different types of trust according to the final model is limited. Trust is only related to membership in political groups and the second cluster of groups identified in Figure 2, being membership in finance groups and burial and festival societies. This means that trust is not correlated to membership in village committees, village NGOs or civic groups, water and waste management groups, education groups, cultural groups or sports groups. The same is true for those groups which were not included in the model: membership in the three agricultural related groups, in health groups and in religious groups.

Another observation is that the relationship among group membership and trust, as hypothesized, depends on the type of trust, but overall is always positive. Trust inside the village is quite central being related to membership in finance groups, political groups and burial and festival societies. Trust in strangers is related to membership in finance groups and in political groups. Trust in local government officials and in agricultural traders is also related to membership in finance groups. Finally, trust in people outside the village and in central government officials is also related to membership in political groups.

6.5.3 Country, village, and household variation

To explore the role of country specific effects we repeated the final path model at the country level (see appendix 6.5a-c.). The relations among trust indicators and among group membership indicators as presented in figure 1 and 2 seem largely robust to country specific effects. However, many of the relations between trust and group membership as presented in figure 3 disappear. For DRC only one relationship remains significant, for Rwanda two, and for Uganda four of which one is negative. This lack of relation between trust and group membership is reflected by the fact that overall goodness-of-fit is acceptable in terms of RMSEA, but not in terms of CFI (see appendix 6.3). Whether this is caused by the differences in country institutions, trust, group memberships or by smaller sample size is left for future research.

Using the regression model specified in section 6.4.2, we also explored whether village and household characteristics influence the correlations we observe in the structural models (see appendix 6.4 for a summary of results[29]). Although various household and village

[29] We only present the coefficients for the variables which were included in our final structural model. Because we do not estimate our regression model as a set of equations it might well be the case that other paths are identified which were not identified in our final structural model, or only identified as indirect

characteristics are related to the level of trust or group membership, they do not influence results: the only path from the final structural model not significant in the regression model is the relationship between trust in people inside the village and membership in financial groups. All other paths are robust to the inclusion of the set of household and village control variables specified in appendix 6.1.

6.6 Conclusion

Social capital is known to play an important role in development. Yet, it is not sufficiently explored in the literature how the different components of social capital are interlinked. In this paper we use factor and path analysis to investigate the relation between different indicators of trust and group membership, two well-known indicators of social capital dimensions. We use the data collected from 2239 households in the framework of the Sub Saharan African Challenge Program in the border region of the DRC, Rwanda and Uganda. We found four important results.

First, social capital is not effectively reflected by one latent factor. This is because trust in different societal groups and group membership are often not correlated. We thus confirm the concerns raised by various authors including Sabatini (2009), Poder (2011) and Quibria (2003). However, few tested these concerns empirically, and none used a confirmatory FA.

Second, all types of trust are positively related although not strong enough to be reflected by one underlying latent factor. Moreover, the indicator of general trust is only weakly correlated with the indicators of trust in specific societal groups. This confirms concerns on whether the well-known "general trust" question from the World Value Survey can be used to infer trust in specific societal groups (e.g. Glaeser et al. 2000).

Third, the relationship across indicators of membership in different groups is weak. This is perhaps not surprising because membership in one group may make it too time consuming, unnecessary or even impossible for someone to join another group. However, although participation in one group is indeed not necessarily related to participation in other groups, we also do not find any significant negative relation. Moreover, we find that participation in some groups is in fact positively related to participation in other groups. In the

paths (i.e. through other indicators of trust or networks). Complete regression results are available upon request.

final path model there are two clusters of relationships among group memberships. One cluster links membership in community groups, agricultural groups, two welfare groups and two socio-cultural groups. The other cluster links membership in financial groups to burial and festival groups. This means that some individuals are likely to participate in multiple groups. This is in line with Wolleback and Selle (2003) who find that multiple affiliations mean more and broader interaction. This implies that participation in one group might results in spill over effects to other groups.

Fourth, indicators of trust and membership in different societal groups are weakly related to each other. Only membership in three out of thirteen groups is significantly and positively related to trust indicators, namely finance and saving groups, burial and festival societies and political groups. The common factor of these groups is probably the role of finance in terms of a social security or entrusted funds (Dercon et al. 2006). Indeed, Fafchamps (2004) contends that where there is information asymmetry and weak legal enforcement mechanisms, as in most sub-Saharan Africa countries, personal trust is an effective substitute for the security provided by the costless legal enforcement. Trust in a number of groups seems to be essential in the formation of groups where finance plays a role. Alternatively, assuming reverse causality, participation in these groups is essential to develop trust in certain societal groups.

Combined these four results should invite researchers and policy-makers to be cautious in interpreting social capital indicators in empirical models. On the one hand, trust or group membership in a specific group cannot be used as an effective indicator of general social capital. On the other hand, trust and group membership can be used to create a social capital index, if this is useful for policy analysis. This would be similar to variables such as "life expectancy" and "literacy" which are not necessarily correlated, but constitute weights for the Human Development Index. Moreover, organisations that try to enhance development by building social capital should carefully consider which component of social capital they try to influence, what kind of effects this may have on other components of social capital, or to which extent other components of social capital are essential for success

This research is clearly exploratory in nature and there are many prospects for future research. First of all, results are only based on data from the Lake Kivu region. Because social capital is known to be a highly context-specific concept, it should be investigated whether data from other regions confirm or contradict our results. Related to this, is to understand the potential effect of institutions on the measurement and relationships between social capital,

group membership and trust. Finally, all relationships found in this paper reflect associations rather than cause and effect. It is of great interest to investigate the causality of these relations more thoroughly in the future.

6.7 Appendix

Appendix 6.1: Summary statistics household and village characteristics (n=2239)

	Mean	Sd	Min	Max
Panel A: Household characteristics				
gender of hh head	0.81	0.39	0	1
age of hh head	45.45	15.09	17	104
education level hh head	3.35	2.21	1	10
highest level of education in hh	4.63	2.51	1	10
size of the hh	6.56	3.24	1	38
males aged 16-58	1.51	1.28	0	12
females aged 16-58	1.56	1.13	0	11
years farming	22.14	14.49	0	80
asset index	2.06	1.34	0	10
visit to extension agent in 2010	0.08	0.28	0	1
visit by extension agent in 2010	0.04	0.20	0	1
research demonstration in 2010	0.05	0.21	0	1
number of rooms	3.69	1.42	0	20
Panel B: Village characteristics				
schools	0.46	0.50	0	1
health centres	0.16	0.36	0	1
boreholes/wells	0.19	0.39	0	1
network coverage for radio	0.43	0.50	0	1
all weather roads	0.52	0.50	0	1
network coverage for mobile phones	0.74	0.44	0	1
no ARD for the past 2-5 years	0.35	0.48	0	1
conventional ARD	0.35	0.48	0	1
IAR4D	0.30	0.46	0	1

Appendix 6.2a: Correlation matrix trust and group membership (n=2239)

		group membership													
		mar	pro	proc	vil co.	vil. ci	pol	w&w	cred	heal	educ	bu&fe	reli	cul	spo
group membership	Marketing	1.00													
	Production	0.08	1.00												
	Processing	.	.	1.00											
	Village committee	0.07	0.15	0.04	1.00										
	Village civic	0.12	0.25	0.06	0.22	1.00									
	Political	.	0.04	.	0.09	0.09	1.00								
	Water and waste	0.10	0.09	.	0.25	0.29	0.07	1.00							
	Credit	.	0.10	.	0.08	0.06	0.22	.	1.00						
	Health	0.05	0.07	.	0.09	0.15	0.28	0.25	0.07	1.00					
	Education	0.13	0.11	.	0.22	0.30	0.09	0.34	0.06	0.24	1.00				
	Burial or festival	.	0.06	.	.	.	0.12	.	0.31	0.16	.	1.00			
	Religious	.	.	.	0.07	0.13	0.21	0.10	0.05	0.16	0.10	0.25	1.00		
	Cultural	0.09	0.13	0.06	0.11	0.16	0.06	0.27	.	0.15	0.32	0.05	0.09	1.00	
	Sports	0.09	0.09	.	0.16	0.27	0.05	0.33	0.05	0.19	0.35	.	0.10	0.36	1.00
Trust	General trust	.	.	.	0.07	0.06	0.08	0.05	.	0.07	0.04	.	0.07	.	.
	Within the village	0.06	.	.	.	.	0.25	0.09	0.17	.	0.07	0.22	0.04	0.06	0.09
	Outside the village	.	.	.	.	.	0.26	0.05	0.13	.	.	0.08	0.10	.	.
	Strangers	.	0.06	.	0.08	0.08	0.21	.	0.13	.	.	.	0.15	.	.
	Local government	.	.	.	.	.	0.30	0.07	0.16	0.14	.	0.09	.	0.09	0.07
	Central government	.	.	.	.	.	0.30	0.07	0.14	0.17	.	0.05	.	0.07	0.06
	Agricultural traders	.	0.04	.	0.10	.	.	.	0.13	0.12	.	0.14	0.11	.	.
	Research institutes	.	0.06	.	.	.	0.18	0.05	0.06	0.18	.	.	.	.	.
	NGOs	.	0.08	.	.	0.05	0.07	.	.	0.04	.	.	.	.	.

Note: only those correlation coefficienst significant at 5% are shown

Appendix 6.2b: Correlation matrix trust and group membership (n=2239)

		trust								
		gener	in. vil	out. vi	stran	.l gov	c. gov	agr. tr	res. in	ngo
Trust	General trust	1.00								
	Within the village	0.29	1.00							
	Outside the village	0.25	0.56	1.00						
	Strangers	0.13	0.29	0.58	1.00					
	Local government	0.18	0.54	0.54	0.43	1.00				
	Central government	0.11	0.42	0.47	0.41	0.80	1.00			
	Agricultural traders	0.15	0.29	0.35	0.33	0.34	0.35	1.00		
	Research institutes	0.12	0.26	0.36	0.29	0.50	0.56	0.33	1.00	
	NGOs	0.14	0.23	0.35	0.29	0.44	0.50	0.34	0.64	1.00

Appendix 6.3: Model fit statistics

Model number*	DF	N	Model Fit Statistics	
			CFI	RMSEA
EFA Social Capital		2239	0.55	0.11
EFA Trust		2239	0.79	0.17
EFA 2 types of trust		2239	0.86	0.14
Trust	25	2239	0.95	0.09
Group membership	16	2239	0.95	0.05
Trust & Group membership	139	2239	0.91	0.06
DRC	128	770	0.82	0.08
Rwanda	129	661	0.89	0.06
Uganda	143	808	0.86	0.07

*We only included the model with the highest fit; the model statistics of the other models are available upon request

Appendix 6.4a: Robustness analysis of household and village characteristics (n=2235)

		group membership										
		pro	proc	mar	vil co.	vil. ci	pol	w&w	cred	heal	educ	bu&fe
group membership	Production		-0.006	0.013	0.101***	0.146***	-0.002	-0.005	0.104***	0.009	-0.001	-0.094***
	Processing	-0.069		0.037	0.112	0.143***	-0.066	-0.078*	-0.010	0.071	-0.068	0.041
	Marketing	0.063	0.015		0.071	0.099***	-0.089*	0.031	0.035	-0.012	0.089***	-0.046
	Village comm	0.070***	0.006	0.010		0.047***	0.049**	0.070***	0.038*	0.013	0.042***	0.026
	Village civic	0.265***	0.022***	0.037***	0.123***		0.051	0.109***	0.010	0.028	0.118***	0.052*
	Political	-0.002	-0.004	-0.015*	0.057**	0.023		-0.001	0.125***	0.163***	0.008	0.138***
	Water and w	-0.013	-0.018*	0.018	0.274***	0.162***	-0.005		-0.017	0.232***	0.133***	0.108***
	Credit	0.075***	-0.001	0.005	0.040*	0.004	0.110***	-0.004		0.043***	-0.005	0.216***
	Health	0.011	0.007	-0.003	0.023	0.019	0.245***	0.104***	0.073***		0.085***	-0.186***
	Education	-0.003	-0.015	0.048***	0.156***	0.167***	0.025	0.127***	-0.018	0.181***		0.105***
	Burial or fest	-0.082***	0.003	-0.008	0.033	0.025*	0.149***	0.035***	0.262***	-0.133***	0.036***	
	Religious	-0.015	0.001	-0.011	0.007	0.045***	0.169***	0.015	-0.024	0.030*	0.018	-0.181***
	Cultural	0.133***	0.020**	0.026*	-0.043	-0.036	0.018	0.094***	-0.016	0.069**	0.154***	0.144***
	Sports	-0.044	0.010	0.006	0.052	0.142***	-0.004	0.152***	0.066	0.074**	0.162***	-0.029
Trust	General trust	-0.006	0.005	0.017**	0.017	0.010	-0.011	0.017	0.005	0.042***	0.005	-0.047**
	Within the vi	0.005	0.004	-0.004	0.005	-0.005	0.031***	-0.009	0.015	-0.013	-0.009	0.067***
	Outside the v	-0.005	-0.006*	-0.006	-0.007	-0.007	0.041***	0.000	-0.005	-0.038***	-0.006	0.014
	Strangers	0.007	-0.003	0.007	0.028**	0.021***	0.022*	-0.008	0.040***	-0.015	-0.002	-0.049***
	Local govern	-0.006	0.004	-0.002	-0.000	-0.011	0.011	0.001	0.011	0.030***	0.002	0.007
	Central gover	-0.003	0.000	0.004	-0.029**	-0.003	0.066***	-0.007	0.012	0.040***	0.000	-0.020
	Agricultural t	-0.001	0.002	-0.008*	0.040***	0.006	-0.043***	0.007	0.018*	-0.061***	0.007	0.028***
	Research inst	0.000	-0.001	0.008*	-0.006	0.001	0.025**	-0.013**	-0.006	0.064***	-0.003	-0.028***
	NGOs	0.023**	-0.004	-0.006	0.011	0.010	-0.046***	0.003	-0.028**	-0.035***	0.005	0.012
HH characteristics Table 1 included (results available upon request)												
Village characteristics Table 1 included (results available upon request)												
N		2235	2235	2235	2235	2235	2235	2235	2235	2235	2235	2235
adj. R-sq		0.107	0.005	0.038	0.142	0.214	0.265	0.245	0.179	0.269	0.273	0.339

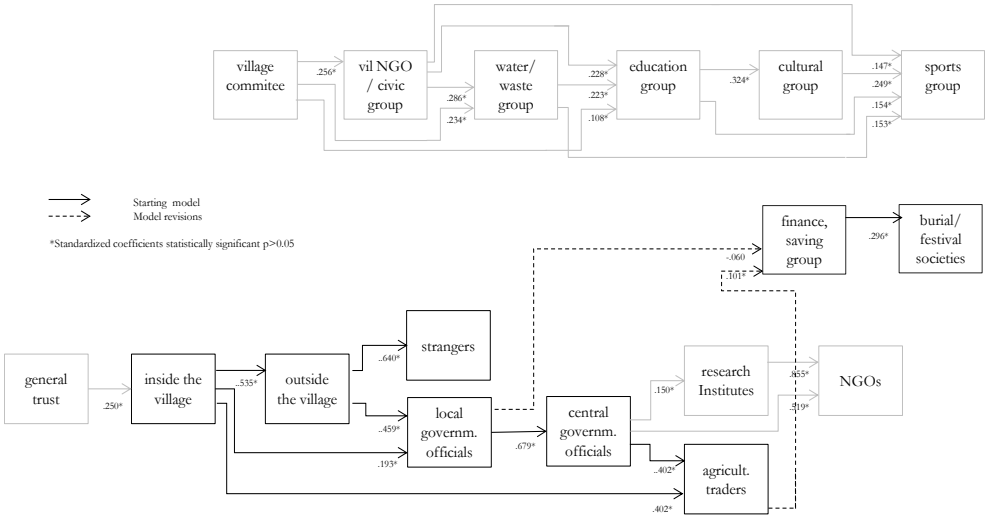
* p<0.10 ** p<0.05 *** p<0.01

Appendix 6.4b: Robustness analysis of household and village characteristics

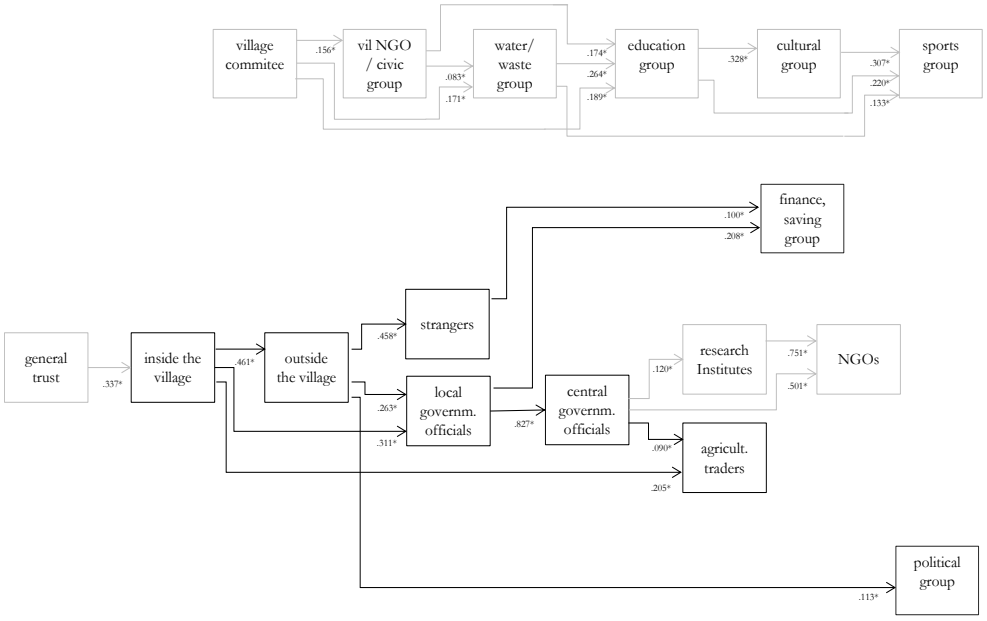
		group membership cont.						trust					
		reli	cul	spo	gener	in. vil	out. vi	stran	l. gov	c. gov	agr. tr	res. in	ngo
group membership	Production	-0.022	0.065***	-0.016	-0.010	0.026	-0.019	0.030	-0.018	-0.011	-0.005	0.000	0.112**
	Processing	0.018	0.116**	0.043	0.087	0.260	-0.252*	-0.129	0.126	0.015	0.124	-0.038	-0.230
	Marketing	-0.075	0.062*	0.011	0.127**	-0.100	-0.094	0.131	-0.027	0.060	-0.196*	0.200*	-0.146
	Village committee	0.007	-0.015	0.013	0.019	0.016	-0.017	0.081**	-0.000	-0.067**	0.146***	-0.020	0.037
	Village civic	0.119***	-0.032	0.091***	0.029	-0.044	-0.043	0.156***	-0.059	-0.015	0.058	0.007	0.088
	Political	0.199***	0.007	-0.001	-0.013	0.125***	0.117***	0.073*	0.027	0.177***	-0.182***	0.102**	-0.182***
	Water and waste	0.058	0.123***	0.145***	0.071	-0.123	0.000	-0.084	0.007	-0.060	0.095	-0.181**	0.042
	Credit	-0.025	-0.005	0.017	0.006	0.054	-0.013	0.119***	0.024	0.030	0.070*	-0.021	-0.098**
	Health	0.053*	0.041**	0.031**	0.079***	-0.079	-0.162***	-0.075	0.108***	0.161***	-0.389***	0.388***	-0.205***
	Education	0.067	0.192***	0.147***	0.021	-0.114	-0.058	-0.021	0.015	0.003	0.097	-0.043	0.064
	Burial or festival	-0.231***	0.061***	-0.009	-0.063**	0.289***	0.044	-0.178***	0.018	-0.058	0.130***	-0.121***	0.050
	Religious		0.022*	0.005	0.021	0.116***	0.058*	0.171***	0.002	-0.058*	-0.196***	-0.121***	0.049
	Cultural	0.067*		0.205***	0.011	-0.032	0.120**	0.018	-0.145***	-0.018	0.129*	-0.016	-0.083
	Sports	0.022	0.283***		-0.018	-0.129	-0.028	0.098	-0.016	-0.083	-0.055	-0.001	0.209***
Trust	General trust	0.020	0.003	-0.004		0.357***	0.143***	-0.051	0.038	-0.113***	0.109***	-0.006	0.096**
	Within the village	0.034***	-0.003	-0.009	0.110***		0.284***	-0.094***	0.195***	-0.012	0.062***	-0.022	-0.035*
	Outside the village	0.024*	0.016**	-0.003	0.062***	0.400***		0.460***	0.094***	0.006	0.057**	0.073***	0.054**
	Strangers	0.060***	0.002	0.008	-0.019	-0.114***	0.394***		0.062***	0.059***	0.173***	-0.021	0.016
	Local government	0.001	-0.024***	-0.002	0.020	0.326***	0.112***	0.087***		0.651***	0.027	0.051*	0.038
	Central government	-0.025*	-0.003	-0.009	-0.053***	-0.018	0.007	0.074***	0.588***		0.095***	0.177***	0.184***
	Agricultural traders	-0.055***	0.012*	-0.004	0.032***	0.059***	0.038**	0.136***	0.016	0.060***		0.111***	0.085***
	Research institutes	-0.035***	-0.002	-0.000	-0.002	-0.022	0.052***	-0.017	0.030*	0.117***	0.117***		0.490***
	NGOs	0.015	-0.008	0.015***	0.031**	-0.036*	0.039**	0.014	0.023	0.125***	0.092***	0.503***	
HH characteristics Table 1 included (results available upon request)													
Village characteristics Table 1 included (results available upon request)													
adj. R-sq		0.183	0.212	0.246	0.120	0.455	0.542	0.410	0.705	0.692	0.290	0.523	0.485

* p<0.10 ** p<0.05 *** p<0.01

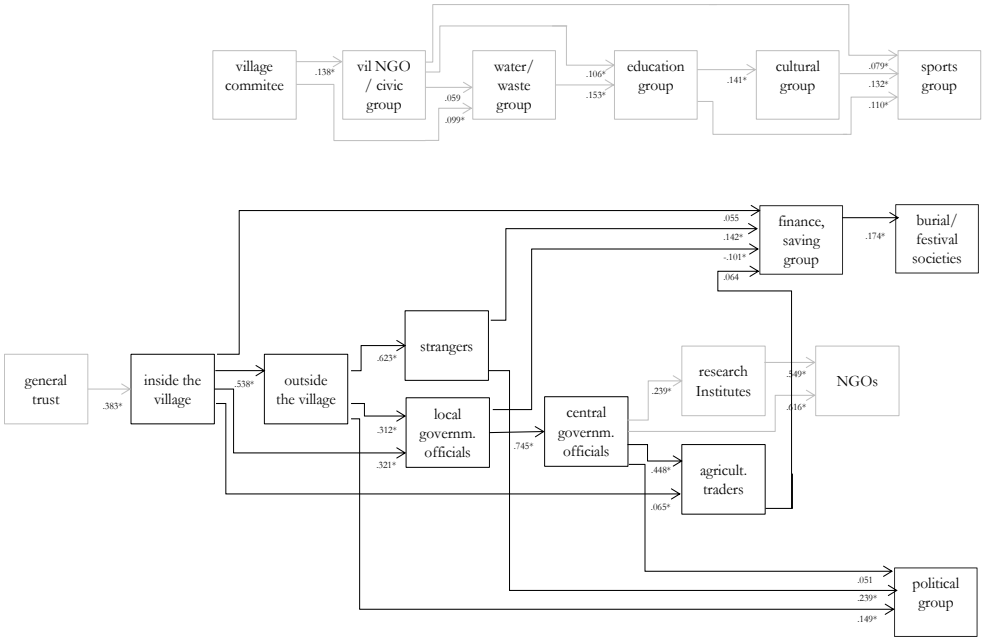
Appendix 5a: Trust and group membership in the DRC



Appendix 5b: Trust and group membership in Rwanda



Appendix 5c: Trust and group membership in Uganda



Chapter 7 Trust and sustainable coffee projects: the relation between producers' trust and the uptake of training practices in sustainable coffee projects in Vietnam

Abstract: In the last decades multinational companies became increasingly involved in certification initiatives to enhance the social and environmental conditions under which coffee is produced. However, it is often unclear whether, for whom and under which conditions these projects result in more sustainable coffee production. If we see uptake of training practices, an important component of these projects, as a result of an exchange of ideas and expectations between different people and institutions it becomes clear that the impact might depend quite extensively on the level of trust. We empirically confirm that higher levels of trust are associated with the higher uptake of training practices as promoted by four sustainable coffee projects in Vietnam. This significant positive relation stems mostly from the effect of institutional trust, especially in combination with high levels of trust inside the village. The association between trust in strangers and uptake of training practices is not significant. We also find tentative evidence that participation in the sustainable coffee projects positively influenced personalized trust in one project whereas it negatively influenced institutional trust in another project. Therefore, implementing agencies should carefully reflect whether and how the impact of their intervention relies on trust, how they could enhance it or at least avoid actions that deteriorate it.

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7.1 Introduction

In the last two decades multinational coffee companies became increasingly involved in initiatives to enhance the social and environmental conditions under which coffee is produced, including certification of coffee (Kolk 2011). However, there is still much uncertainty related to the impact of certification, and of sustainable coffee projects in general (Kolk 2011; van Rijn et al. 2012). Moreover, most impact assessments have focused on the evaluation of average impacts on producers (Bacon 2005; Utting-Chamorro 2005; Pirotte et al. 2006; Ruben et al. 2009; van Rijn et al. 2012). Little attention is generally paid to the distribution of program benefits (Raina 2003). Without this understanding, it is uncertain whether these sustainable coffee projects will yield similar benefits to other households or in other contexts (Deaton 2009). It thus remains unclear whether, for whom and under which conditions these projects result in more sustainable coffee production.

One aspect that could explain heterogeneity in impact of sustainable coffee projects is the level of trust. More specifically, we argue that trust plays an important role in one of the key impact pathways in the coffee supply chain at producer level - namely in the uptake of training practices. We conceptualise uptake of training practices as an outcome of an "innovation system" in which producers, trainers and institutions exchange knowledge and form agreements. This view agrees with the insight that agricultural innovation results from the integration of knowledge from various actors and stakeholders, implying a focus on interdependence, networks and social learning (Leeuwis and Ban 2004; Röling 2009). Whether or not, and for whom, interventions in the coffee supply chain have the intended results might thus depend on the level of trust. We contribute to closing this knowledge gap.

Trust is one of the main components of social capital which is generally defined as the norms of cooperation, the social networks and the level of trust characterizing a household or community. Various scholars identify the importance of social capital for the evaluation of development interventions (Isham and Kähkönen 2002; Mansuri and Rao 2004; Deaton 2009). In relation to agricultural innovation most empirical studies focus on the role of the second component – the networks. Monge et al. (2008) for example show that households who are better embedded in social networks in rural Bolivia are more likely to adopt the agricultural innovations brought to them by various interventions. However, far less attention has been paid to the role of trust. One example is the study by de Hoop and van Kempen (2011) who find that households with higher levels of trust in healthcare providers adopt more bed nets as

provided by healthcare providers. The influence of trust on uptake of agricultural training by farmers or agricultural innovation in general is unclear (De Hoop 2012; Landry et al. 2002).

We empirically tested the hypothesis that a higher level of trust is associated with higher uptake of the training practices as promoted by four sustainable coffee projects among 240 randomly selected project participants. Uptake of training is defined as the average application of practices related to pruning, soil management, irrigation, pesticide application, harvesting and processing of coffee. Additionally, we hypothesize that trust is more important for high risk practices than it is for low risk practices. Trust was measured using self-reported levels of trust in strangers (generalized trust), in several institutions (institutional trust) and inside the village (personalized trust). If trust indeed matters, it is relevant to know whether trust was influenced by the sustainable coffee projects. This is explored in the second part of our analysis where we compared the self-reported change in trust of project participants to that of 150 carefully selected comparable producers who did not participate in a sustainable coffee project. We used a regression analyses to control for a large number of household, farm and unobserved community level characteristics that might influence uptake of training or the level of trust.

In Section 7.2 we discuss the rise of sustainable coffee projects in general, and the sustainable coffee projects in Vietnam in particular. In Section 7.3 we discuss our theoretical framework defining trust, specifying how it relates to social capital, and formulating hypotheses on the relationship between trust and uptake of agricultural training practices. In Section 7.4, we summarize our data and describe the model that we used to estimate the relationship between trust and uptake of training practices. We discuss and conclude our results in Section 7.5.

7.2 Sustainable coffee projects

7.2.1 Sustainable coffee projects, certification and impact

Several voluntary standards for sustainable coffee have been developed in the coffee sector in the last two decades (Kolk 2011). With the lifting of export quotas in the early nineties, production expanded significantly in Brazil and new entrants such as Vietnam. As a result of over-supply, the price for coffee fell by more than 50% between 1997 and 2001 contributing to the poor living conditions of small-scale coffee producers worldwide (Linton 2005). Conventional aid activities, in which no partnership was sought with the private sector, did not seem to improve these conditions significantly or prevent potentially hazardous effects of

coffee production on the environment from occurring. NGOs started a strong lobby towards multinational companies to take their responsibility in the supply chain (Kolk 2011). The top-5 multinational companies, who control almost 50% of the processing and commercialization of coffee, became increasingly involved in initiatives to enhance sustainable coffee production (Ponte 2002). In fact, certification of commodities is an increasingly common way to ensure that producers and other value chain partners such as traders and exporters adhere to pre-defined social, environmental and in some cases technical standards. Global supply of certified sustainable coffee has risen from about 1% in 2001 to 9% in 2010. Supply growth of conventional coffee averaged around 2% over the same period (author's calculation, based on ICO data).

Certification schemes are often implemented as part of a sustainable coffee project involving the organisation of small scale producers. Seventy per cent of coffee is produced by an estimated 20 million small-scale producers (Kolk 2011). Some of these producers are member of cooperatives, but the majority operate as individuals. Aside from a lack of management and administrative skills, individual smallholder coffee producers cannot profitably access the market for certified coffee because they lack sufficient volumes over which to spread implementation costs. Given the large and fragmented supply base, addressing demand for certified sustainable coffee requires trading and exporting companies to organize producer groups and use these as a basis for implementation of certification.

Besides the organisation of small scale farmers, certification requires a certain amount of training to comply with the certification standards and address other modifications to further professionalize crop and farm management (Don Jansen in Kuit et al. 2013). This combination of compliance and professionalization should result in value for producers, aside from the premium, by facilitating long-term improvements in productivity, quality and cost efficiency. Uptake of training practices is the focus of this paper.

There is still much uncertainty related to the impact of certification, and of sustainable coffee projects in general (Kolk 2011; van Rijn et al. 2012). The evidence to support claims of various certification agencies on improvement in productivity, quality and cost efficiency is very modest (Steering Committee of the State-of-Knowledge Assessment of Standards and Certification 2012). A meta-study commissioned by the Scientific and Technical Advisory Panel of the Global Environment Facility (2010) reviewed 134 studies that claim to assess the impact of certification in different sectors, including coffee. Out of these only 14 were deemed sufficiently rigorous in their research design to appear credible and only six of

these identified some positive socioeconomic or environmental impact at farm level. The authors conclude that the evidence for positive impact of certification is, at best, very weak. Moreover, it remains unclear why some sustainable coffee projects are more successful than others. As was argued in the introduction, one of the aspects that could explain heterogeneity in impact is social capital.

7.2.2 Project description sustainable coffee projects in Vietnam

This paper was written in the framework of a study commissioned to investigate the effectiveness and efficiency of different projects that seek to promote sustainable coffee production in Vietnam. Vietnam is the second-largest exporter of coffee, the largest exporter of Robusta coffee and one of the dominant suppliers of certified coffee. Coffee production in Vietnam is characterised by a high degree of labour and input intensification. Furthermore, its literacy rate is higher than that of other Robusta coffee producing countries such as Cote d'Ivoire, Cameroon and Uganda (World Bank 2012). Within Vietnam, the provinces of Dak Lak and Gia Lai were selected for research. The two provinces produce about half of Vietnam's coffee (Nguyen and Tuan 2012). Dak Lak represents the relatively more mature coffee areas, characterized by older tree stocks, some with declining productivity. Gia Lai is a more recently established coffee area with a younger tree population and tends to be more productive.

In the study, we distinguished three implementation modalities that were used to achieve certification: high intensity, medium intensity and low intensity (see Kuit et al. 2013 for results). These levels of intensity refer to the quantity and quality of training. There is a growing realisation that what leads to impact at farm level is not so much sustainable certification as such, but more the way in which it is achieved. The high intensity training project was implemented by a multinational exporter. It has certified about 800 coffee producers since 2008 and uses a farmer field school (FFS) approach which is a group-based, experimental learning approach. The medium intensity training project was implemented in 2011 by an NGO and is a relatively small project with 46 participants. The low intensity project was implemented by a national exporting company and certified almost 1800 producers since 2007. A fourth project was also included in the study which was implemented in 2005 by a multinational exporting company using only FFS training without certification.

7.3 Theoretical framework

7.3.1 Trust, innovation and training uptake

The idea that trust matters for agricultural innovation stems from the "innovation system" approach. It is increasingly recognized that agricultural innovation results from the integration of knowledge from various actors and stakeholders, implying a focus on interdependence, networks, learning, and social interaction (e.g. Leeuwis and Ban 2004; Röling 2009). This view suggests that agricultural innovation should be linked to social capital (see section 2.4 and chapter 4). The overall influence of social capital is often described as forming an "innovative milieu" (Dakhli and De Clercq 2004) or a "factor" of innovation) (Kaasa 2009).

Although the exact mechanisms through which social capital operates vary, it is usually linked to the notion of cooperation. Cooperation can be seen as driven by preferences for cooperation and beliefs in the cooperative behaviour of others (Thöni et al. 2012). Below we argue that beliefs and preferences for cooperation will be more optimistic with a higher level of trust.

Trust can generally be understood as an optimistic expectation or belief regarding someone's behaviour (Fafchamps 2004). The more optimistic this expectation, the more likely it is people will cooperate. In fact, trust in people one is interacting with is a key ingredient in many economic and non-economic transactions (Guiso et al. 2010).

Trust can be classified into to generalised, institutionalised and personalised trust (Groenewald and Bulte 2012). Personalised trust refers to trust in existing networks and most closely corresponds to bonding social capital. Generalised trust refers to trust in strangers and most closely corresponds to bridging trust. Institutional trust refers to trust in more formal governance networks and most closely corresponds to linking social capital.

7.3.2 Sustainable coffee projects and trust

Following Röling (2009), we define an innovation as "the process of technical and institutional change at farm and higher levels .". In this paper we consider the act of applying sustainable coffee training practices as an innovation. We hypothesize that the impact of training given within sustainable coffee projects depends on the beliefs in and preferences for cooperation. We first focus on a commonly used measure of trust, namely that of generalized trust, defined as trust in strangers. In theory, generalized trust is considered the dimension of trust that makes institutions and markets function properly (Guiso et al. 2010). Our first hypothesis is as follows:

(H1): a higher level of generalized trust of producers participating in sustainable coffee projects is associated with a higher uptake of agricultural training practices by these producers.

Quotes from in-depth interviews, conducted as part of the overall research project, confirm that trust indeed matters in the context of the sustainable coffee projects investigated in this paper. One respondent for example mentioned that "Even if I trust the project, I don't know if the people who will keep our money are credible [referring to the cooperative]". The impact of training clearly depends on producers' beliefs on the likelihood that the trainer and institute they represent keep their word as to the results of implementing the training practices. Furthermore, our survey evidence indicates that 45% of the coffee producers do not apply any of the training received on organisational development because of a lack of trust among producers. These examples illustrate how trust might promote or hinder cooperation, cooperative development and consequently project impact through uptake of training practices. At the same time this quote illustrates that the effect of trust might depend on specific types of trust, rather than generalized trust. Therefore we formulate more specific hypothesis with respect to institutional and personalised trust.

We expect that trust in the institutions that provide the training, and the people that represent them, matter for the uptake of training practices. Following Fafchamp's (2004) understanding of trust, this means the producers have more optimistic beliefs about the value of the practices communicated and the action that should results from implementing these practices. For example in terms of an increased price level for certified coffee. Obviously it matters whether producers trust the institutions and individuals representing them to comply with this.

(H2): a higher level of institutionalised trust of producers participating in sustainable coffee projects is associated with a higher uptake of agricultural training practices by these producers.

In line with the theory of social learning we expect personalised trust, defined as trust inside the village in this study, to enhance the application of the training practices. The main reason why trust in fellow producers matters for uptake of training practices is that faster social learning can occur within networks characterized by a high level of trust (De Hoop and Van

Kempen 2012). This enhanced social learning is linked to the idea that famers share and use more information with and from producers they trust (e.g. Bandiera and Rasul 2006; De Hoop and Van Kempen 2012). In the literature, personalised trust is probably most often connected to agricultural innovation. In fact, the few papers that address the role of trust in agricultural innovation are usually related to trust in social networks within the village.

At the same time some authors have also argued that strong bonding social capital might hinder agricultural innovation by promoting promote conservatism and inward looking behaviour (Dakhli and De Clercq 2004, chapter 3). This is especially true when bridging and linking social capital is low (Knack and Keefer 1997). Therefore, the net effect of personalised trust is ambiguous. However, combined with high levels of bridging social capital, we expect that personalised trust can act as a catalyst in reinforcing the positive effect of social capital on agricultural innovation. This results in our third hypothesis:

(H3): a high level of personalised trust of producers participating in sustainable coffee projects is only associated with a higher uptake of agricultural training practices by these producers when combined with a high level of generalized or institutionalized trust.

We expect the role of trust to depend on the level of risk and uncertainty involved in applying a new practice. In the hypotheses given before, we assume that the effect of trust is identical for all agricultural training practices. However, a risk averse farmer will only decide to adopt the practice when the expected, but unsure, outcome is significantly larger than that of the current practice (e.g. Conley and Udry 2001). The training provided by the projects, and interaction with fellow villagers in these projects, provide a platform to learn about the potential benefits of the new practice and overcome the uncertainty involved. We hypothesize that the trust between the interacting parties increases the value of shared information about the prospects of a new practices, hence reducing uncertainty and risk. If a practice does not involve risk or uncertainty, trust may be (less) important. This is also argued by De Hoop and van Kempen who find that trust inside the village only matters for the uptake of tomatoes, which is considered a risky crop in terms of demand, and not for the adoption of French beans. This results in our fourth and last hypothesis:

(H4): a high level of trust of producers participating in sustainable coffee projects is associated more strongly with the uptake of high risk training practices than with the uptake of low risk training practices.

If our hypotheses are confirmed, and trust indeed matters, we have an important follow-up question: can trust be influenced by the participation in sustainable coffee projects? Considering the important role of trust identified in the previous section, we explore whether sustainable coffee projects can potentially enhance uptake of training by increasing the level of trust, in particular by increasing institutional trust. Many authors argue that social capital, especially trust, is the result of long-term historic processes (see Fearon et al. 2009 for an overview). However, empirical evidence also indicates that social capital can be influenced by external development interventions (Bebbington and Carroll 2002; Krishna and Uphoff 2002), even in the short term (Fearon et al. 2009; Labonne and Chase 2011).

7.4 Data and empirical strategy

7.4.1 Sample

Structured interviews were conducted among 264 participating coffee producers. For three of the four projects we randomly selected about 75 producers using a complete list of participants. For the other project we interviewed almost all participants because of its small population of 46 producers. In total, 15 communities were involved. To construct a counterfactual for the impact assessment, *i.e.*, what would have happened if the projects would not have been implemented, we also conducted structured interviews among 150 purposefully selected coffee producers that were not involved in any sustainable coffee project. First we selected communities comparable to those in which the projects were implemented[30]. In the six selected communities, we designed a half-day training session. The opportunity to participate was announced a few days in advance assuming we would attract farmers similar to the project farmers in terms of motivation. In Table 1 we provide an overview of the sample groups in our study.

[30] Communities were first short listed based on the importance of coffee as a livelihood. Next, a matrix with 14 key agro-ecological and socio-economic variables was constructed and filled out with the assistance of the respective Departments of Agriculture and Rural Development of each of the provinces. Based on this matrix we rated and selected six comparable communities.

Table 1: Sample

Implementation modality	Training intensity	Certification	Province	n
P1: FFS + certification	high	yes	Gia Lai	76
P2: low + certification	low	yes	Dak Lak	75
P3: medium + certification	medium	yes	Gia Lai	44
P4: FFS only	high	no	Dak Lak	79
Control group farmers	n.a.	n.a.	Gia Lai & Dak Lak	150

7.4.2 Estimation strategy

We estimate the amount of practices applied (*Y*) for household *i* as a function of a vector of trust variables (*T*), the project a famer participates in (*P*), a set of controls (*X*) and a set of dummies of the community a farmer lives in (*C)* :

$$Y_i = f_1(T_i, P_i, X_i, C) \quad (1)$$

We estimate the model using Ordinary Least Squares and control for characteristics that simultaneously influence trust and uptake of training practices in three ways. First, we control for a large number of observed household characteristics (see section 7.4.3). Second, we control for the impact of unobserved project or community level characteristics by estimating project and community level fixed effects. This essentially means we include dummy variables for each project and each community. Third, we estimate model (1) only for the treatment group. This prevents omitted variables that simultaneously determine project participation and uptake of training practices from influencing our results. Given the data at hand, there might still be unobserved factors that we cannot control for. Therefore, we interpret results as associations rather than causal relationships[31].

According to H1 and H2, we unbundle trust, *T*, into general, institutional and personalised trust. To test H3 we add interaction effects between personalised and generalised trust and between personalised and institutionalised trust. The interaction effect represents the

[31] Another way to address the potential bias resulting from unobserved factors or reverse causality is to estimate a 2SLS using an instrumental variables (IV) approach. In this case, the IV should directly explain trust, but not uptake of training practices. The literature has identified some useful IVs for social capital variables, such as religion, ethnicity, land rights or community aggregate trust (e.g. Grootaert and Narayan, Guiso et al. 2006, Nunn and Wantchekon 2011, Groenewald and Bulte 2012, Kondelys 2008). However, at this stage no valid instruments were identified. Finding a plausible IV will be subject to future research.

residual part of the product of the two variables after the original variables have been partialed out (see Ross and Creyer 1993)[32]. To test H4 we estimate model (1) separately for high-risk and low risk training practices.

To explore the influence of the sustainable coffee projects on trust we estimate the self-reported change in the nth dimension of trust since 2008 (C) for household *i* as a function of the project a farmer participates in (*P*), and the set of controls relating to human, social, physical, financial and natural capital (*X*):

$$C_{n,i} = f_{2,n}(P_i, X_i), i \in 1,2,3 \quad (2)$$

We repeat model (2) for the nth indicator of trust. Self-reported change in trust (*C*) is 1 when *increased*, 0 when the *same*, and -1 when *decreased*. We compare these changes to the changes of producers from the control group by estimating an ordinary least square model for our entire sample. Again we include community dummies to control for unobserved community level fixed effects.

7.4.3 Uptake of training practices

Uptake of training practices was based on the following survey question: "How much of what you have learned do you apply in your farm for the following topic". The topics included pruning, soil management, pesticide application, irrigation, harvesting and processing. These indicators were measured on a 0 to 4 scale, where a score of 0 means "none", 1 means "some practices", 2 means "half of the practices", 3 means "more than half of the practices" and a score of 4 means "all".

To test our hypotheses, we created an "average application" index of the six agronomy-related training areas. Especially pruning, irrigation and soil management are seen as important drivers for productivity and profitability (Marsh 2007). Pruning requires large amounts of labour, while irrigation and soil management, in particular application of fertilisers, entail major capital expenditures. To test our fourth hypothesis, we differentiate between high risk and low risk topics. We define irrigation and soil management practices as high risk. The use of irrigation and fertilizers, an important component of soil management, are considered a hedging strategy against potential yield loss (Cheesman et al. 2007). In the context of Vietnam,

[32] This means we run a regression with the product of two types of trust, T_j and T_k: $T_jT_k = \beta_0 + \beta_1 T_j + \beta_2 T_k + \varepsilon$, where ε represents the interaction. This makes it possible to maintain a correct interpretation of the original variables and prevent multicollinearity.

implementing training practices would mean a reduction of irrigation and nutrients, with uncertain implications for yield. In Table 2 we present a summary of our outcome indicators. On average producers apply slightly more than half of the practices and there is not much difference between high risk and low risk practices.

Table 2: Application of training

	n	mean	sd	min	max
Average application of training	242	2.53	0.98	0.33	4.00
High risk training practices	240	2.51	1.21	0.00	4.00
Low risk training practices	242	2.55	1.01	0.25	4.00

7.4.4 Trust

The level of trust was measured using the following survey question: "In general, how would you describe your trust in the following people?" based on the World Bank Social Capital Group Survey. These indicators were measured on a 1 to 5 scale, where a score of 1 means "very poor" and a score of 5 means "very good". In total eight different groups of people were identified based on their relevance in the coffee supply chain. The most important critique on these types of survey questions is that it is not clear whether we measure someone's preference for cooperation or someone's beliefs about others' cooperative behaviour, called trustworthiness, or a combination of the two (Fehr 2009). For example, Thöni et al. (2012) indicate that the general trust survey question captures the preference-based component, whereas the analysis by Sapienza et al. (2013) suggest it is the belief-based component. However, in both papers as well as others there is a clear correlation between the answers to the survey question of trust and actual cooperative behaviour in behavioural experiments (see Guiso et al. 2010 for an overview).

Considering the hypotheses at hand we use three indicators to represent the dimensions of trust at household level. Generalized trust is represented by trust in strangers. Institutional trust is represented by an index of trust in local government officials, central government officials, agricultural traders, research institutes and NGOs. Personalized trust is represented by trust inside the village. The appropriateness of the index is supported by the fact that the underlying variables are positively and significantly correlated and reflected by one

factor in our factor analysis[33]. The three dimensions of trust are not significantly correlated illustrating that they indeed represent different dimensions of trust as hypothesized in section 7.3. In Table 3, we present a summary of our trust indicators. On average trust in strangers is somewhere between very poor and poor, trust in institutions is not poor, nor good and trust inside the village is good.

Table 3: Evaluation of trust in 2012

	n	mean	sd	min	max
Trust in strangers	274	1.58	0.78	1.00	4.00
Trust in institutions (index)	268	3.33	0.65	1.60	5.00
Trust inside the village	274	4.08	0.73	1.00	5.00

7.4.5 Household and farm characteristics

To appropriately measure the relationship between trust and uptake of training practices, we need to control for the wide range of other characteristic acknowledged in the literature that might influence the uptake of training. If producers with higher levels of trust also show more or less of these characteristics, we might get biased results; that is we might capture the relationship between these characteristics and uptake, rather than between trust and uptake. We control for a range of personal, physical, institutional and socio economic characteristics of the farm households (see Edwards-Jones 2006; Feola and Binder 2010 for an overview of variables that influence training uptake). In Table 4 we present summary statistics for the project participants.

In the design of the impact study these characteristics were classified according to the five capital assets as identified in the sustainable livelihood framework (DFID 2007). In this paper we classify them accordingly. Under human capital we include gender of the respondent, the highest obtained education level in the household, a dummy for ethnic minority household, household size, household dependency ratio (the ratio of people outside versus inside the

[33] Exploratory Factor Analysis (EFA) is used to explore whether our institutional trust indicators are sufficiently and consistently correlated so that they can be measured by one underlying latent variable or factor. In EFA the number of factors is determined by the variance extracted within each factor, or eigenvalue. According to the Kaiser criterion, only factors with an eigenvalue > 1 are retained (Kaplan 2008). In our analysis this indeed results in one factor.

workforce) and experience in coffee. We also add the number of training sessions inside and outside the project since 2008. Looking at the role of trust, it is essential to control for another essential component of social capital namely membership of coffee and non-coffee related groups. We use size of coffee field, productivity and average age of coffee trees as proxies for natural capital. Physical capital comprises the basic infrastructure and producer goods needed to support livelihoods, represented by an index of equipment. Financial capital denotes the financial resources that people use to achieve their livelihood objectives and is captured by ownership of land (rather than rent), dependency on coffee income and an asset index to proxy for wealth. All variables are either fixed, not influenced by the sustainable coffee projects, or based on recall data of 2008.

Table 4: Descriptives control variables (n=274)

	mean	sd	min	max
Panel A: Human capital				
Gender respondent	0.15	0.36	0.00	1.00
Education level household	4.56	1.37	0.00	7.00
Ethnic minority household	0.90	0.30	0.00	1.00
Household size	5.05	1.43	2.00	12.00
Household dependency ratio	45.41	52.39	0.00	300.00
Experience coffee	18.27	5.13	4.00	34.00
Training outside the project since 2008	8.52	10.37	0.00	78.00
Training in the project since 2008	10.78	11.28	0.00	80.00
Panel B: Social capital				
Membership coffee related groups 2008	1.66	1.30	0.00	5.00
Membership other groups 2008	0.70	0.90	0.00	5.00
Panel C: Natural capital				
Size coffee field 2008	1.36	1.00	0.20	7.50
Productivity 2008	3.35	1.27	0.00	10.00
Average age coffee trees	16.13	5.15	3.00	32.00
Panel D: Physical capital				
Equipment index 2008*	4.03	1.29	0.00	6.00
Panel E: Financial capital				
Ownership farm 2008	1.63	0.73	0.00	2.00
Dependency on coffee income 2008	3.52	0.73	1.00	4.00
Asset index 2008**	4.80	1.77	0.00	10.00

*sum of water pump, irrigation pipes, tractor, electricity, hulling equipment, drying yard
**sum of washing machine, fridge, gas cooker, electric rice cooker, mobile phone, computer, internet, bicycle, motorbike, car

We include the same set of control variables in model (2) to explore the effect of the sustainable coffee projects on trust. These are often identified to influence the level of trust or social capital in general (e.g. Elder et al. 2012). We also add a dummy for Dak Lak province[34] and a household level dummy indicating whether or not one of the household heads was born in the district they currently live in.

7.5 Results

7.5.1 Trust and uptake of training practices

We first look at the average level of training uptake for each level of trust. In Table 5 we see that the relation between trust and uptake of training depends on the type of trust. There is no consistent relationship between trust in strangers and uptake op training practices. However, trust in institutions is clearly higher for those with a higher level of training uptake. The same is true for personalized trust, measured as trust inside the village, although there is a slightly lower level of uptake among those respondents with a very high level of trust.

Table 5: Level of training uptake by level of trust

	Uptake of practices by		
Level of trust	trust in strangers	trust in institutions*	trust inside village
very poor	2.48	-	1.75
poor	2.47	2.04	2.08
not poor, nor good	2.68	2.39	2.12
good	2.31	2.77	2.62
very good	-	3.51	2.50

*this variable is re-categorized to 1 (1-1.4), 2 (1.5-2.4), 3 (2.5-3.4), 4 (3.5-4)

The results of model (1) in the first column of Table 6 clearly show that the role of trust indeed depends on whether we measure generalized, institutional or personalised trust. We reject our first hypothesis that application of training practices can be explained by generalized trust. On the other hand, the results strongly support our second hypothesis that uptake of training practices is related to institutional trust. A one point increase of institutional trust is

[34] Please note that we did not include this as a control variable in model (1) because each project is implemented in only one province. Because of high multicollinearity between the project dummies and the province dummy it is impossible to estimate a model including both.

associated with an increase of the training index of 0.397 on a scale of 0.33 to 4. The coefficient of trust inside the village is also significantly positive, although much lower at 0.160. Other characteristics that are related to increased levels of training uptake are the amount of training sessions received inside the sustainable coffee projects and the level of productivity in 2008. Interestingly, the effect of training is slightly lower than that of institutional trust[35].

Table 6: Empirical result model 1

	Uptake practices	**Uptake practices**	**Uptake High risk practices**	**Uptake Low risk practices**
Trust in strangers	-0.116	-0.115	-0.135	-0.107
	(-1.59)	(-1.57)	(-1.39)	(-1.40)
Trust in institutions	0.397***	0.411***	0.356***	0.423***
	(4.31)	(4.46)	(2.87)	(4.38)
Trust inside the village	0.160**	0.164**	0.118	0.164**
	(2.11)	(2.17)	(1.17)	(2.07)
Trust strangers * inside the village		-0.035	-0.058	-0.021
		(-0.39)	(-0.49)	(-0.23)
Trust institutions * inside the village		0.183*	0.130	0.181*
		(1.87)	(1.01)	(1.78)
P1: FFS + certification	0.179	0.205	0.021	0.327
	(0.91)	(1.03)	(0.08)	(1.57)
P2: Low training + certification	-0.327*	-0.331*	-0.605***	-0.207
	(-1.91)	(-1.92)	(-2.66)	(-1.15)
P3: Medium training + certification	0.091	0.120	0.076	0.232
	(0.39)	(0.51)	(0.24)	(0.95)
Gender respondent	-0.052	-0.086	-0.217	0.010
	(-0.32)	(-0.52)	(-1.00)	(0.06)
Education level hh	0.031	0.028	-0.030	0.050
	(0.71)	(0.63)	(-0.49)	(1.08)
Training outside project since 2008	0.001	0.000	0.002	-0.002
	(0.20)	(0.04)	(0.20)	(-0.26)

[35] Standardized coefficients are 0.261 for institutional trust, 0.246 for amount of training sessions and 0.112 for productivity.

Training in the project since 2008	0.021***	0.022***	0.020**	0.024***
	(3.28)	(3.45)	(2.32)	(3.56)
Ethnic minority household	-0.098	-0.146	-0.061	-0.184
	(-0.47)	(-0.69)	(-0.21)	(-0.84)
Household size	-0.061	-0.055	-0.087	-0.043
	(-1.45)	(-1.31)	(-1.56)	(-0.99)
Household dependency ratio	-0.002*	-0.002*	-0.002	-0.002
	(-1.96)	(-1.76)	(-1.30)	(-1.63)
Experience coffee	-0.010	-0.011	0.008	-0.015
	(-0.69)	(-0.78)	(0.40)	(-1.01)
Membership coffee related groups 2008	0.042	0.044	0.048	0.043
	(0.76)	(0.81)	(0.65)	(0.74)
Membership other groups 2008	0.016	0.009	0.050	0.004
	(0.22)	(0.12)	(0.51)	(0.06)
Size coffee field 2008	-0.077	-0.078	-0.082	-0.082
	(-1.25)	(-1.27)	(-1.00)	(-1.27)
Productivity 2008	0.088*	0.073	0.096	0.070
	(1.72)	(1.41)	(1.38)	(1.30)
Average age coffee trees	-0.008	-0.000	-0.016	0.005
	(-0.55)	(-0.01)	(-0.82)	(0.32)
Equipment index	0.032	0.027	0.113*	0.004
	(0.68)	(0.58)	(1.78)	(0.08)
Ownership farm 2008	-0.179**	-0.175**	-0.095	-0.208**
	(-2.12)	(-2.07)	(-0.85)	(-2.36)
Dependency on coffee income	-0.052	-0.045	-0.047	-0.056
	(-0.62)	(-0.54)	(-0.41)	(-0.63)
Asset index	-0.016	-0.014	-0.031	-0.004
	(-0.45)	(-0.39)	(-0.65)	(-0.11)
Constant	1.329*	1.211	1.516	1.109
	(1.80)	(1.63)	(1.54)	(1.43)
n	256	256	247	256

Note: all estimations include a constant, community, dummies

* p<0.10 ** p<0.05 *** p<0.01, Standard errors in parentheses

In the second column we find some evidence for the hypothesis that personalised trust is particularly important when generalised or institutional trust is high. The relationship between

uptake of training practices and personalised trust increases when institutional trust is also high: amongst producers that have a high level of trust inside the village and in institutions the uptake of training is even higher. This is not true for the interaction between trust inside the village and trust in strangers.

We do not find any evidence to support our fourth hypothesis that the role of trust is larger for the uptake of high risk training practices (see column 3 and 4 in Table 5). In fact, if anything, we find the opposite. The role of trust inside the village is not significant for high risk training practices whereas it is for low risk training practices. Moreover, the coefficient for trust in institutions is lower for high risk training practices than it is for low risk training practices.

A major concern of any work related to social capital is that social capital is not exogenous to the model because it is correlated with unobserved factors, it is reverse-caused by current economic factors or it reflects the working of institutions (Guiso et al. 2010). This could bias results of an OLS regression. We already control for a large number of observed and unobserved factors that might influence trust or uptake of training thereby limiting the chance for omitted variables bias. It is also unlikely that current trust is influenced by the uptake of training. However, it might be that those who consider the project more successful, and have applied more training, indicate higher levels of trust because they are more optimistic. This especially applies to institutional trust. If this is the case we should find that producers with a higher uptake of training are also those producers who indicate more increase in institutional trust since the start of the project. We test this by replacing our institutional trust indicator by the change in institutional trust since 2008. We do not find any positive significant correlation that indicates that our results are driven by perceived successfulness of the projects (see appendix 7.1). Interestingly, the negative coefficient of generalised trust now becomes significant, indicating that those who have less generalised trust implement more training practices. Whether this results is robust and what explains this, is topic to future research.

7.5.2 Exploring the impact of sustainable coffee projects on trust

23% of the respondent in our sample indicate a change in trust in strangers, 65% indicate a change in trust inside the village, and 70% indicate a change in trust in at least one of the institutions. This supports the view that trust is very dynamic. In Table 7 we present the average change in trust for each sustainable coffee project and compare it to the change in the

control group within the same province. We see an overall increase in trust inside the village and trust in institutions across all groups, although there is significantly more increase in the low training + certification group (see Panel A). We find a decrease in trust in strangers for all groups.

Table 7: Change in trust since 2008

	Change in trust in strangers	**Change in trust in institutions**	**Change in trust inside village**
Panel A: Dak Lak			
Control group	-0.11	0.26	0.47
Project 2: Low + cert.	-0.11	0.37*	0.69**
Project 4: FFS only	-0.16	0.23	0.48
Panel B: Gia Lai			
Control group	-0.08	0.33	0.51
Project 1: FFS + cert.	-0.09	0.24	0.51
Project 3: Med + cert.	-0.05	0.26	0.45

Note: decrease (-1), same (0), increase (1)
* p<0.10 ** p<0.05 *** p<0.01 (significantly different from the control group in the same province)

Results of model (2) in Table 8 indicate that project participation can have a significant influence on trust, although not for all trust indicators and projects, and not necessarily positively.

First, when we control for other characteristics, participants of the FFS + certification project indicated significantly less increase in trust in institutions than the control group. Based on the in-depth interviews we speculate this might be because of unmet expectations and lack of communication. One producer from this project for example said: "They were explaining and convincing us to join the cooperative, but after one or two trainings, they just disappeared. We didn't see any project staff over the past year. I don't even know where the project office is". Another producers said "However, for an unknown reason, the company didn't buy the certified coffee with a premium this year" At the same time, this type of comments was not limited to this project. Therefore, miscommunication and unmet expectations were either more prevalent in this project or had more severe consequences. Alternatively, the reason why especially this project has experienced less increase in trust lies

elsewhere. Characteristics that have a positive impact on trust are origin from the same district, training sessions outside the project, and membership in coffee related groups in 2008.

Second, results confirm that the higher increase in trust among participants in the low training + certification project resulted from project participation. Besides participation in this project, only the number of training sessions outside the project seems to have a positive influence, whereas the asset index has a negative influence. We are unable to determine for certain why it is especially this project that resulted in increased trust inside the village. However, we speculate it might be because this project, which is probably the most commercially-led of all, probably selected as many farmers from the same villages as possible to minimize costs of operation. Furthermore, even though participation was voluntary, this project seemed to have selected especially those producers that show promising yields. The selection by the organisation, versus self-selection, might have increased the likelihood that producers were not yet familiar with each other yet, thus providing more room for trust building.

Table 8: Empirical result model 2

	Change in trust in strangers	**Change in trust in institutions**	**Change in trust inside village**
P1: FFS + certification	-0.013	-0.187***	-0.006
	(-0.14)	(-2.74)	(-0.05)
P2: Low training + certification	-0.100	0.087	0.244**
	(-1.17)	(1.38)	(2.19)
P3: Medium training + certification	0.040	-0.047	-0.032
	(0.41)	(-0.65)	(-0.25)
T4: FFS only	-0.115	-0.091	0.013
	(-1.40)	(-1.47)	(0.12)
Gender respondent	-0.047	-0.046	-0.067
	(-0.67)	(-0.86)	(-0.73)
Education level hh	0.027	0.008	-0.024
	(1.47)	(0.58)	(-1.00)
Origin same district	0.182**	0.133**	-0.110
	(2.27)	(2.14)	(-1.05)

Training outside project since 2008	-0.003	0.005*	0.008*
	(-0.82)	(1.84)	(1.85)
Training in the project since 2008	0.006*	-0.001	-0.006
	(1.79)	(-0.35)	(-1.37)
Ethnic minority household	0.054	0.025	0.076
	(0.66)	(0.40)	(0.71)
Household size	-0.003	0.001	-0.010
	(-0.19)	(0.10)	(-0.46)
Household dependency ratio	-0.000	-0.000	-0.000
	(-0.40)	(-0.39)	(-0.37)
Experience coffee	0.008	-0.000	-0.013
	(1.33)	(-0.02)	(-1.62)
Membership coffee related groups 2008	0.010	0.064***	0.022
	(0.38)	(3.27)	(0.64)
Membership other groups 2008	0.037	-0.015	-0.015
	(1.12)	(-0.59)	(-0.35)
Size coffee field 2008	0.015	0.013	0.001
	(0.61)	(0.70)	(0.03)
Productivity 2008	0.026	0.019	-0.014
	(1.28)	(1.24)	(-0.53)
Average age coffee trees	-0.017***	-0.005	0.002
	(-2.88)	(-1.21)	(0.30)
Equipment index	-0.015	-0.014	0.008
	(-0.77)	(-0.98)	(0.33)
Ownership farm 2008	-0.019	0.029	0.004
	(-0.52)	(1.10)	(0.09)
Dependency on coffee income	0.035	-0.003	-0.046
	(1.12)	(-0.14)	(-1.11)
Asset index	-0.025	-0.016	-0.039*
	(-1.61)	(-1.39)	(-1.96)
Daklak	0.060	-0.030	0.030
	(0.69)	(-0.45)	(0.26)
Constant	-0.224	0.266*	1.111***
	(-1.17)	(1.83)	(4.42)
n	422	408	422

Note: all estimations include a constant, community, dummies

* p<0.10 ** p<0.05 *** p<0.01, Standard errors in parentheses

To test the robustness of these results we use two alternative model specifications and look at the current level of trust in the different sustainable coffee projects. As a first robustness test, we use a model that takes into account the fact that the original data is categorical rather than continuous. An OLS estimation could bias results. Also, we combine the change in the different institutional trust indicators which might hide effects on the individual indicators. We already saw that participation in the sustainable coffee projects might result in more increase in trust but also in more decrease. We therefore use a multinomial logit model and essentially estimate equation (2) twice: one comparing a decrease versus the same, and one comparing an increase versus the same (see appendix 7.2). As a second robustness test, we estimate model (2) using the current level of trust as an outcome variable rather than self-reported change in trust since 2008. If the projects resulted in an increase or decrease in trust this should also be reflected in current levels of trust if we have a good control group (see appendix 7.3). Both robustness analyses confirm the negative impact of participation in the FFS + certification on trust in institutions. The multinomial logit results confirm the positive impact of participation in the low training + certification on an increase in trust inside the village. However, the current level of trust inside the village does not seem to be higher than in the control group. This could mean that trust was not influenced, but it could also mean that trust was different to start with and our control variables do not pick up the cause of these differences.

7.6 Discussion and conclusion

In the last two decades multinational coffee companies became increasingly involved in initiatives to enhance the social and environmental conditions under which coffee is produced, including certification of coffee. However, it is unclear whether, for whom and under which conditions these projects result in more sustainable coffee production. Training of producers has an important, if not decisive role. When we see uptake of training practices as a result of an exchange of ideas and expectations between different people and institutions it becomes clear that the impact of training might depend quite extensively on the level of trust. In this paper, we empirically test and confirm the hypothesis that a higher level of trust is associated with a higher uptake of training practices as promoted by four sustainable coffee projects in Vietnam. In fact, of all household and farm characteristics we included in our analysis, the level of trust seems to have the highest correlation to uptake of training practices.

We find that the relation between trust and uptake of training practices depends on whether we measure generalized, institutional or personalised trust. The significant positive

relation between trust and uptake of training practices stems mostly from trust in institutions. Trust inside the village, our measure of personalised trust, is also positively associated to uptake, although the coefficient is much lower. Trust in strangers, our measure of generalized trust, is not significantly correlated to uptake of training practices. This result is interesting because a large part of the literature on social capital and trust claim that it is especially this type of trust that matters for economic development (e.g. Guiso et al. 2010). Although this might be true for other areas of development, our results show that this is not necessarily the case for agricultural innovation. Interestingly, this is supported by evidence from various other countries as well. For example, de Hoop et al. (2010) find that trust in health providers is more important than generalized trust for the adoption of bed nets in Ghana. Furthermore, Cassar et al. (2007) find that trust between group members is more important than generalized trust in predicting loan repayment in Armenia and South Africa.

We also find some evidence that the role of personalised trust is higher with high levels of institutional trust. The relation between uptake and our measure of bonding social capital, personalized trust, is even higher in combination with higher levels of our measure of bridging social capital, institutional trust. This confirms the idea that bonding and bridging social capital are complementary (Knack and Keefer 1997). However, it is also important to note that we do not find any evidence for a detrimental effect of bonding social capital, for example by promoting inward-looking modes of behaviour that defer agricultural innovation (e.g. Dakhli and De Clerq 2004, chapter 3). Contrary to the results by De Hoop and van Kempen (2012) we find no difference between the role of trust in uptake of low risk or high risk training practices.

In the second part of our analysis we find tentative evidence that participation in the sustainable coffee projects has had an influence on trust. A large body of literature suggests that social capital is historically derived (e.g. Putnam 2000), is a result of long-run evolutionary processes (Bowles and Gintis 2001) or is shaped by critical junctures in history (Nunn and Wantchekon 2011). Our results indicate that participation in at least one of the projects resulted in significantly higher increase in trust inside the village. This supports an increasing number of studies that show that social capital can indeed be influenced by external interventions, even in the short term (Uphoff and Wijayaratna 2000; Fearon et al. 2009; Labonne and Chase 2011). On the other hand, participation in another group resulted in significantly less increase in trust in institutions. The idea that development interventions might have negative side-effects on existing levels of social capital is not new. Elder et al. (2012) for

example show that Fair Trade resulted in a decrease in trust in leaders in Rwanda. Vollan (2012) shows that a high level of externally initiated committees resulted in lower levels of trust in South Africa. He argues that the negative impact on trust is likely driven by unfulfilled expectations, a lack of downward accountability and transparency or poor coordination. In-depth interviews conducted for this survey pointed in similar directions. A caveat to these results is that they are based on the level of self-reported trust in a non-randomly selected treatment and control group.

Nonetheless, we think these results have essential implications for the implementation and design of sustainable coffee projects, and development interventions in general. Implementing agencies should realize that trust, especially institutional trust, is very important for the uptake of training practices. They should carefully reflect whether and how the impact of their intervention relies on trust, how they could enhance it or at least avoid actions that deteriorate it. This is not only important for the success of the specific intervention, but also for preventing potentially long lasting negative side-effects from occurring. Because it is not yet entirely clear under which conditions development interventions can or do influence trust, programs could also target those households who have higher levels of trust to start with, as for example suggested by de Hoop et al. (2011). However, they rightly argue that trust is not easy to observe and thus difficult to use as a selection criteria. Moreover, it might not be realistic or ethical to exclude producers who are a potential target. An alternative is to work with already existing groups or stimulate producers to form their own groups, rather than defining those groups top-down.

Considering the limited amount of research investigating the link between trust and the success of sustainable coffee projects, in this case the uptake of training practices, there is plenty of room for follow-up research. Future research should identify the differences in the relationship between trust and training uptake in the different sustainable coffee projects. For example, we might expect that the role of trust inside the village is more important for those initiatives that require a lot of interaction between producers, such as the FFS approach. Second, this paper addressed the role of trust in uptake of training practices, a direct outcome indicator. It would be interesting to see whether trust also has role further down the impact chain, for example in relation to yield or costs of production. Third, it would be particularly interesting to see whether our results can be generalized to other development initiatives or other countries. Finally, even though we control for various factor that might bias our results because trust is not exogenous, we would like to see our results confirmed if we a find a

plausible instrument or could replicate this study as truly semi-experimental or at least using baseline data.

7.7 Appendix

Appendix 7.1 Robustness analysis for the relation between trust and training uptake (n=255)

	Uptake of practices
Trust in strangers	-0.131*
	(-1.68)
Change in trust in institutions	0.246
	(1.46)
Trust inside the village	0.150*
	(1.91)

Note: all estimations include a constant, community . dummies, and the set of control variables
* p<0.10 ** p<0.05 *** p<0.01, Standard errors in parentheses

Appendix 7.2: Multinomial logit robustness analysis for the impact of projects on trust

	Trust in:						
	Strangers	Local Govern.	Central Govern.	Agricult. Traders	Resear. Institut.	NGOs	Inside village
decrease							
P1: FFS + cert.	0.022	18.501***	16.300***	0.686	-22.723	-1.085	0.815
P2: Low + cert.	1.939***	-0.373	-2.598*	0.703	-41.781	0.370	-0.650
P3: Medium + cert.	-1.256	18.318***	-12.689	-0.556	21.195***	-0.709	1.320
T4: FFS only	0.919*	0.286	-0.524	1.015	0.539	1.179	0.809
increase							
P1: FFS + cert.	-0.816	-0.742*	-1.177***	-0.223	-1.244***	-1.365**	0.130
P2: Low + cert.	1.856**	0.204	-0.050	0.994**	0.278	0.058	0.770*
P3: Medium + cert.	-36.908	-0.246	-0.700	-0.438	-0.185	0.069	0.158
T4: FFS only	0.358	-0.766**	-0.584	0.534	0.023	-0.510	0.361
N	422	424	421	423	419	414	422

* p<0.10 ** p<0.05 *** p<0.01
Note: the control variables are all included but left out to save sapce; results are avalaible upon request

Table7.3: Robustness analysis for the impact of projects on current level trust

	Trust in strangers	**Trust in institutions**	**Trust inside village**
P1: FFS + certification	0.071	-0.295***	-0.016
	(0.48)	(-2.72)	(-0.12)
P2: Low training + certification	-0.004	0.319***	0.015
	(-0.03)	(3.17)	(0.12)
P3: Medium training + certificatio	0.206	-0.048	-0.025
	(1.32)	(-0.42)	(-0.18)
T4: FFS only	-0.126	0.081	-0.143
	(-0.95)	(0.83)	(-1.18)
n	424	411	424

* p<0.10 ** p<0.05 *** p<0.01, S

Note: all estimations include a constant, community dummies, and the set of control variable

Chapter 8 Conclusion

8.1 Main findings

In this thesis I show that social capital should have an important role in the evaluation of development initiatives targeting agricultural innovation. This is specifically true for the increasing number of policies, programs and projects that include beneficiaries in the design, management and decision making process. I broadly define social capital as the participation in formal and informal networks, the norms that define behaviour in these networks and the trust within and outside these networks. Even though social capital is something which exists between people, it has a clear individual attribute. Therefore, I consider network participation and trust as individual attributes of social capital, which may or may not be aggregated at village level. I distinguish four dimensions of social capital; structural bonding, structural bridging, cognitive bonding and cognitive bridging. Participation in networks is used as a proxy for structural social capital, whereas norms and trust within and between these networks is used as a proxy for cognitive social capital. In this thesis, bonding and bridging social capital is akin to social capital inside and outside the village.

I empirically investigate the relationships between social capital, agricultural innovation and two types of development initiatives. The first is the implementation of agricultural research through the Integrated Agricultural Research for Development (IAR4D). IAR4D was adopted by the Sub Saharan African Challenge Program (SSA CP) and implemented in eight different countries (FARA 2009). The core of this approach is the development of Innovation Platforms (IPs), which can be described as an informal coalition and alliance of conventional agricultural research and development actors. Using the semi experimental data collected in this context, I could investigate the important role of social capital in different contexts. The second type of initiative is implementation of sustainable certification schemes through group-based experimental learning approaches. I investigate four sustainable coffee projects in Vietnam, of which two adopted the interactive Farmer Field School training approach. The data of these four projects allow me to verify some of the conclusions from a different context and a different development initiative.

I find that social capital is important for development initiatives targeting agricultural innovation in the three ways proposed in chapter 1 (also see figure 1). First, social capital is

associated with agricultural innovation (arrow *i*). Second, development initiatives can influence social capital (arrow *ii*). Third, the existing level of social capital is associated with the success of development interventions (arrow *iii*). However, the effect of social capital or the impact of a development initiative on social capital was not necessarily positive and depends greatly on the aforementioned dimension of social capital. The latter is also supported by the fact that different dimensions of social capital are not necessarily related. Below I discuss these findings in more detail.

8.1.1 The role of social capital in agricultural innovation

The important role of social capital in processes of agricultural development and innovation is increasingly recognized (e.g. Narayan and Pritchett 1999; Isham 2002; Bandiera and Rasul 2006). Yet, the existing literature about the different dimensions of social capital and how they contribute to agricultural innovation is limited. In the theoretical discussion in chapter 2 it became clear that not all dimensions of social capital are conducive to agricultural innovation.

In chapter 3, I empirically test whether and how different dimensions of social capital are associated with the adoption of agricultural innovation. I use the baseline data collected by the SSA CP for a large sample of African smallholders in eight Sub Saharan African countries. Agricultural innovation is measured as an aggregate index of a variety of innovations in the domains of land management, post-harvest management and production enhancing innovations. In Chapter 2, I unbundle social capital into structural bonding, structural bridging and cognitive bonding social capital. I find that social capital is associated with agricultural innovation in different ways.

Structural bridging social capital is significantly and positively related to the level of agricultural innovation. This result is true for the pooled model as well as for four of the country models. This form of social capital captures agriculture-related links creating access to knowledge and resources and is considered an important dimension of economic development (e.g. Fafchamps 2004; Granovetter 2005). The effect of structural bonding social capital remains ambiguous.

I find a negative association between cognitive bonding social capital and the innovation index. This result emerges both in the pooled data and some of the country models. This finding could represent a potentially harmful side of social capital in terms of agricultural innovation. High levels of cognitive social capital might result in inward-looking modes of behaviour, displace time and resources away from agricultural innovation, or promote create

conflict between groups (e.g. Knack and Keefer 1997; Bowles and Gintis 2001; Dakhli and De Clercq 2004; Kaasa 2009) .

8.1.2 The effect of development initiatives on social capital

Considering the important role of social capital for development, economic and otherwise (Woolcock 2010), development aid has invested significantly in efforts to increase social capital. Under the banner of community-driven development programs, there has been an enormous increase in projects that include beneficiaries in the design and management of the project, and that stress the importance of information sharing, capacity building, and strengthening the organisations that represent them (Mansuri and Rao 2004). A good example is the IAR4D approach. However, whether external initiatives can actually influence social capital is still topic of debate (Gugerty and Kremer 2002; Pronyk et al. 2008; Fearon et al. 2009; Casey et al. 2012).

In chapter 4, I use semi-experimental data collected in the context of the SSA CP to investigate the impact of the IAR4D approach on social capital in one of the pilot sub regions –the border region between Rwanda, Uganda and the DRC. Social capital is defined similar to chapter 3, and grouped into structural bridging, structural bonding and cognitive bonding social capital. I compare the impact of IAR4D on these dimension of social capital to that of traditional Agriculture Research and Development (ARD). I find that IAR4D has influenced social capital, although not in all its dimensions and not consistently for all countries. Furthermore, I show that traditional ARD has been less successful.

More specifically, I find that IAR4D has increased structural bridging social capital in the DRC and Uganda, but not in Rwanda. Whether the IAR4D approach has had a positive impact on structural and cognitive bonding social capital remains ambiguous. I find some tentative evidence that IAR4D has had a positive impact on bonding social capital, but this effect is not confirmed by the main estimation model.

However, in chapter 7, I provide tentative evidence that cognitive social capital can be influenced by development initiatives. Using data collected among participants of four sustainable coffee projects and carefully collected control groups in Vietnam, I find suggestive evidence for the fact that participation in the sustainable coffee projects has affected trust. Our results indicate that participation in at least one of the projects resulted in a significant increase in trust inside the village. This supports the growing amount of evidence that social capital can

be influenced in the short term (e.g. Pronyk et al. 2008; Fearon et al. 2009; Labonne and Chase 2011).

However, the impact of development interventions on social capital is not necessarily positive. In chapter 7, I also find tentative evidence that participation in one of the sustainable coffee projects in Vietnam actually had a negative influence on trust in institutions. The idea that development interventions might have negative side-effects on existing levels of social capital is not new. Elder et al. (2012) for example show that Fair Trade resulted in a decrease in trust in leaders in Rwanda. Vollan (2012) shows that a high level of externally initiated committees resulted in lower levels of trust in South Africa. He argues that the negative impact on trust is likely driven by unfulfilled expectations, a lack of downward accountability and transparency, or poor coordination. In-depth interviews conducted for the evaluation of the sustainable coffee projects in Vietnam pointed in similar directions.

8.1.3 Social capital as a catalyst for the success of development initiatives

Various scholars identify the importance of social capital as a catalyst for the success of development initiatives (Isham 2002; Mansuri and Rao 2004; Dasgupta 2005; Baliamoune-Lutz and Mavrotas 2009; Deaton 2009). The evaluation literature suggests two ways in which initial levels of social capital matters. First, outcomes of a policy may vary if the policy is implemented by different organisations; the organisations may possess different organisational and managerial capacities and have different efficiency levels (Heckman, 1991; Deaton, 2010; Allcott & Mullainathan, 2012; Bold et al., 2013). Second, the impact of any development initiative may be a function of population characteristics of the region where the project is implemented (Heckman, 1991; Deaton, 2010). Social capital is a potentially important source of differences in implementation and impact.

In chapter 5, I find tentative evidence that the initial level of village social capital influences the successful implementation of the IAR4D approach. The successful implementation of IAR4D is measured by quantifying the five defining principles of IAR4D into an IAR4Dness index. I argue that IPs may not have implemented the principles of the IAR4D approach in the same way across IPs. This might explain the heterogeneity in impact of IPs identified in chapter 3 (also see Pamuk et al. 2012). Indeed, I find that the index is positively and significantly correlated with the household Food Consumption Score (FCS). Looking at the sub-components of each principle it seems especially participation in information sharing activities and field visits was crucial for project success. Involvement in

these activities is higher in communities with a higher level of education, a higher percentage of female headed households, and a higher level of village social capital in terms of trust and gift exchange. Whether this effect is causal, still needs to be confirmed. However, the analysis also indicates that the effect of IAR4Dness on FSC does not operate through the increased levels of social capital observed in chapter 3.

In chapter 7, I investigate whether cognitive social capital explains differences in the uptake of training practices, a key component of sustainable coffee projects (Kuit 2013). It remains unclear whether, for whom and under which conditions these projects result in more sustainable coffee production (Kolk 2011; van Rijn et al. 2012) Using survey data collected among 240 randomly selected coffee project participants, I empirically test the hypothesis that higher levels of trust increase the uptake of the training practices as promoted by four sustainable coffee projects in Vietnam. I distinguish between trust in strangers, institutions, and inside the village. I also distinguish between the uptake of high and low risk training practices. The relation between trust levels of respondents and the uptake of training practices is particularly relevant.

The significant positive relation between trust and the uptake of training practices stems mostly from the impact of trust in institutions, which is a measure of bridging social capital. The role of trust inside the village, which is bonding social capital, is also positive although the coefficient is much lower. I also find some evidence that the role of bonding trust is higher with high levels of bridging trust. This confirms the idea that bonding and bridging social capital are complementary (Knack and Keefer 1997). Contrary to the results in chapter 3, I do not find indications of a detrimental effect of high levels of cognitive bonding social capital on innovation; the relation between trust inside the village and uptake of training.

The relation of trust in strangers to uptake of training practices among project participants is not significant. This result is interesting because a large part of the literature on social capital and trust claims that it is especially this type of trust that matters for the impact of social capital on economic development (Guiso et al. 2010). Although this might be true for other areas of development, the result in chapter 7 shows that this is not necessarily the case for agricultural innovation. This is supported by evidence from various other countries as well (Cassar et al. 2007; De Hoop and Van Kempen 2010).

8.1.4 Relationship between the different dimensions of social capital

In answering the main research questions, I found that the role of social capital depends greatly on the dimension of social capital measured; that is structural bonding, structural bridging, cognitive bonding or cognitive bridging. However, the existing literature does not provide an unambiguous answer to how these dimensions are related. In chapter 6, I find that the different dimensions of social capital are in fact not necessarily related, as is often implicitly assumed.

Using factor and path analysis I investigate how group membership, an important component of structural social capital, is related to trust, and important component of cognitive social capital. I use data from one of the pilot learning sites of the SSA CP: the border region of the DRC, Rwanda and Uganda. I distinguished between trust in people inside the village, outside the village, strangers, local and central government officials, research institutes, traders and NGOs. I also distinguished between membership in community, agricultural, cultural, welfare, financial and political groups. All variables were measured at the individual level.

I find that different types of trust and group membership are often not correlated. This confirms the concerns raised by various authors including Sabatini (2009), Poder (2011) and Quibria (2003). Only membership in three out of thirteen groups is significantly and positively related to the trust indicators, namely finance and saving groups, burial and festival societies and political groups. The common factor of these groups is probably the role of finance in terms of social security or entrusted funds (Fafchamps 2004; Dercon et al. 2006). Indeed, Fafchamps (2004) contends that where there is information asymmetry and weak legal enforcement, as in most sub-Saharan Africa countries, personal trust is an effective substitute for the security provided by the legal enforcement.

However, the relationship among different indicators of trust is strong and positive, although not strong enough to be reflected by one underlying latent factor. This significant relation is not true for the indicator of general trust, which is only weakly correlated with the other indicators of trust. This confirms concerns regarding the use of a specific question from the World Value Survey related to "general trust", to infer trust in specific societal groups (e.g. Glaeser et al. 2000).

The relationship across indicators of membership in different groups is weak; membership in one group may make it too time consuming, unnecessary or even impossible

for someone to join another group. However, rather than a negative correlation we find that participation in some groups is in fact positively related to participation in other groups. This means that some individuals are likely to participate in multiple groups. Multiple affiliations could mean that participation in one group results in spill over effects to other groups (Wollebæk and Selle 2003).

8.2 Policy and research implications

Agricultural innovation, and agricultural development more generally, is a vital condition for alleviating poverty in many developing countries (e.g. Duflo and Kremer 2005; World Bank 2007; De Janvry 2010; Diao et al. 2010; Christiaensen et al. 2011). This thesis has several implications related to the role of social capital in the design, implementation and evaluation of development initiatives that target agricultural innovation. These implications are important to the ever increasing number of policies, programmes or projects for which networks, trust and norms of cooperation are either the basis for success or form an outcome as such. This specifically applies to those initiatives that include the beneficiaries in the design and management of the project and stress the importance of information sharing, capacity building, and strengthening civic societies that represent them (Mansuri and Rao 2004).

The first implication is that stimulating social capital, especially bridging social capital, may be a natural leverage point for policy makers to promote agricultural development. This is a dimension of social capital which is generally thought to be important, if not vital, to economic development. Insofar as education or other policies contribute to relaxing the push for conformity, enhanced adoption of agricultural innovation may be a by-product. However, it appears as if cognitive bonding social capital can also be a factor that impedes adoption of agricultural innovations. Therefore, it might be appropriate to do a careful evaluation of the context in terms of the existing level of different dimensions of social capital; especially focussing on the balance between bonding and bridging social capital. This can be done before implementation of a program based on existing social capital data- such as the World Value Survey –baseline data, or more qualitative research methods such as focus group discussions.

The second implication is that increased levels of social capital can indeed be an outcome of development initiatives, either intentionally or not. I have shown that an intervention such as IAR4D can successfully influence the networks linking a village to partners outside the village. This result was found in two regions with divergent institutional contexts. I also showed that creating an impact on structural social capital requires specific

efforts, because traditional ARD did not yield similar results. However, IAR4D did yet not yet have a strong significant impact on cognitive bonding social capital. It thus remains questionable whether development initiatives can influence cognitive social capital if this is required. At the same time, I find tentative results that the impact on cognitive bridging social capital might have been negative in a sustainable coffee project in Vietnam. Because these are not stand-alone results (e.g. Elder et al. 2012; Ruben and Heras 2012; Vollan 2012) implementing agents should carefully reflect whether their initiatives might have a negative effect on social capital. This could for example be done by monitoring the changes in social capital using standardized monitoring tools or through frequent interaction with target group beneficiaries. Issues that could be addressed are the identification of unmet expectations, lack of downward accountability and transparency or poor coordination (e.g. Vollan 2012).

The third implication is that social capital might matter for the success of certain development initiatives, either as a source of heterogeneous implementation or impact. More specifically, I show that institutional trust is important for the uptake of training practices. Therefore, the existing level of trust should be taken into account when training is used as a tool to improve agricultural training practices. For example, by incorporating trust-building modules to create awareness of potential mistrust, the barriers this mistrust could create and ways to improve upon this.

A fourth implication is that it is vital to take into account the multi-dimensional nature of social capital and the fact that these dimensions might have different relations to agricultural innovation and development initiatives. Moreover, the different dimensions are not necessarily related to each other. These results should invite researchers and policy-makers to be cautious in interpreting social capital indicators in empirical models. On the one hand, different dimensions and indicators of social capital cannot be used as an effective indicator of general social capital. On the other hand, they can be used to create a social capital index, if this is useful for comparative country analysis in line with Doing Business or World Wide Governance Indices. This would be similar to variables such as "life expectancy" and "literacy" which are not necessarily correlated, but constitute weights for the Human Development Index. Moreover, organisations that try to enhance development by building social capital should carefully consider which dimension or indicator of social capital they try to influence, what kind of effects this may have on other dimensions of social capital, or to which extent other dimensions of social capital are essential for success.

Combined these implications mean that indicators of social capital should be included in the design and analysis of evaluation tools of agriculture-related development initiatives. There has been an increased interest in measuring the impact of agriculture-related development initiatives, and of development aid more generally (Duflo and Kremer 2005; Deaton 2009; De Janvry 2010). Including social capital indicators in these impact evaluations might be used to enhance capturing the characteristics of the agents involved, the informal institutional context in which they operate, and the mechanisms through which these program results in impact. In doing so, impact assessment better captures the fact that impact results from a combination of the mechanisms, the institutional context and the agents involved (also see Ekboir 2003; Mackay and Horton 2003; Deaton 2009).

Some of the implications might also apply to initiatives in other sectors of development. The role of social capital is much broader than its role agricultural development alone. For example, Woolcock (2010) identified at least nine fields of studies where social capital has played an important role: families and youth behaviour problems, crime and violence; schooling and education, community life, work and organisations, democracy and governance, collective action problems, and economic development. The implications related to agricultural development initiatives, might also apply to the design and evaluation of policies, programs and projects in some of these other fields of development.

8.3 Limitations and future research

Considering the limited amount of research investigating the link between social capital, agricultural innovation and development initiatives, there is plenty of room for follow-up research. Suggestions for follow-up research are related to the identification of causality, the definition and measurement of social capital and agricultural innovation processes, heterogeneity in results across countries and development initiatives, and longer term effects. Many of these suggestions are related to the limitations of this thesis.

A first area of future research is to further unravel the chains of causation between different dimensions of social capital, agricultural innovation, and development initiatives. Given the cross-sectional and semi-experimental data which underlie this thesis there are still concerns of endogeneity that need to be addressed, particularly that of reverse causality and omitted variables bias. An increasing number of studies addresses the causality between development initiatives and social capital using experimental data (Pronyk et al. 2008; Fearon et al. 2009; Casey et al. 2012). The causal link between specific dimensions of social capital and

agricultural innovation is also increasingly investigated, for example by using extensive network data (e.g. social learning by Conley and Udry 2010). However, the multidimensional nature and effects of social capital are often not addressed. Moreover, there is a need to empirically confirm that social capital is a catalyst for the success of development initiatives, especially at micro level (De Hoop and Van Kempen 2010 is perhaps one of the few examples).

Second, future research should validate the indicators and indices of social capital using experimental games or more advanced survey questions, and/or better embedding them in existing theories. One option is to follow up on the work by authors such as Sapienza et al. (2013) and Thöni et al. (2012). These authors compare outcomes from various experimental games that measure generalised trust to survey measures of trust. It would be useful to replicate this work in a developing country context and for other dimensions of trust. Another option is to test the usefulness of survey questions that explicitly frame the question in a probability framework. An example is "Suppose that a random person you do not know personally receives by mistake a sum of 1000 Euros that belong to you. He or she is aware that the money belongs to you and knows your name and address. He or she can keep the money without incurring in any punishment. According to you what is the probability (a number between zero and 100) that he or she returns the money?" (see Guiso et al. 2009). Moreover, future research should further investigate how and to which extent the different dimensions and indicators underlying social capital can be aggregated to become useful for policy or evaluation purposes. Finally, in line with chapter 6, future research should address the empirical, but also conceptual and theoretical, overlap between the different indicators and dimensions of social capital. For example with respect to concepts such as culture or informal institutions, or theories such as social psychology or game theory (Durlauf 2002).

Third, future research could advance in the measurement of innovation as a truly "interactive, participatory and embedded process". I do not study the innovation process in detail. Instead, I study the role of social capital in the adoption of specific types of knowledge embodied in agricultural practices, varieties or inputs used. Moreover, I study the effect of social capital at farm level and not at higher levels in the impact or value chain. In doing so, I may underestimate the full effect of social capital on agricultural innovation.

Fourth, future research could address whether the importance of social capital, as a catalyst for success or as an outcome variable, depends on the nature of the development initiatives. In this thesis, I compare different agricultural development initiatives to "community driven development" projects. I do this based on the notion that these projects

often include beneficiaries in the design and management of the project and stress the importance of information sharing, capacity building, and strengthening civic societies that represent them. However, there is a difference between the exact nature of these initiatives. For example, in chapter 4 I show that the more interactive approach IAR4D was successful in influencing social capital, whereas traditional ARD was not. This might also be the case for the sustainable coffee projects I discuss in chapter 7. The role of cognitive bonding social might be more important for projects that use group-based Farmer Field School approaches than for projects that do not.

A fifth important area for future research is to explore the differences in results across countries. For example, I find that cognitive social capital is positively associated with innovation in the DRC, whereas the association is negative in some other countries. I also find that the impact of the IAR4D approach on social capital is strongest in DRC. These differences across countries also emerged when analysing the relationships between different dimensions of social capital. Therefore, it is of interest to see how social capital interacts with other country characteristics, but also to further explore differences across regions or even communities. Various authors address the link between social capital and institutions (Tabellini 2005; Ahlerup et al. 2009; Baliamoune-Lutz and Mavrotas 2009; Baliamoune-Lutz 2011). However, the existing literature mostly focuses on macro level institutions. It would be of particular interest to investigate the interaction between social capital and micro level formal institutions such as rule of law or property rights. An interesting line of research might be to combine microeconomic statistical analysis with historical accounts on how current institutions came into being and have been interacting with social capital (see Woolcock et al. 2011 for an account of why history matters, and why historian should be involved).

Finally, research yet has to address the long-run effect of development initiatives on social capital. I find that IAR4D has significantly influenced structural social capital. I also provide tentative evidence that both initiatives investigated in this thesis might have had an impact on cognitive social capital. Whether or not the impact on structural social capital is durable and the impact on cognitive social capital becomes significant on in the long run, is not clear. This area of research is particularly important considering the increasing number of studies that find a potentially negative side effect of development initiatives on social capital. The end line survey , which is has been approved for one of the pilot learning sites of the SSA CP, will provide opportunity to evaluate how social capital developed after the end of the first phase of the project, especially considering the fact that most IPs now operate independently.

When combined, these data, collected between 2008 and 2014, can also be used to address some of the other limitations related to causality and a more elaborate definition of innovation.

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Summary

In this thesis, I show that social capital has an important role in the evaluation of development initiatives targeting agricultural innovation. Social capital and agricultural innovation are naturally linked from an innovation system perspective in which innovations result from the integration of knowledge from various actors and stakeholders. In chapter 1, I identify the three research questions upon which this thesis is based. First, how are social capital and agricultural innovation related? Second, can development initiatives increase agricultural innovation by building social capital? Third, does the initial level of social capital increase the success of these development initiatives in enhancing agricultural innovation? These question mainly relate to the increasing number of policies, programs and project that include beneficiaries in the design, management and decision making process.

In chapter 2, I elaborate on the main concepts underlying this thesis including social capital, how it relates to development initiatives in the agricultural sector, and how it can be measured. I broadly define social capital as the participation of individuals in formal and informal networks, the norms that define these networks and the trust these individuals have within and outside these networks. Participation in networks is structural social capital, whereas norms and trust within and between these networks is cognitive social capital. I distinguish four dimensions of social capital: structural bonding, structural bridging, cognitive bonding and cognitive bridging. In this thesis bonding and bridging social capital is akin to social capital inside and outside the village. Agricultural innovation is defined in terms of improved land and crop management practices, an important area of agricultural innovation for small scale producers.

In chapter 3 till 7, I empirically investigate the relationships between social capital, agricultural innovation and two types of development initiatives. The first initiative is the implementation of agricultural research through the Integrated Agricultural Research for Development (IAR4D) approach. IAR4D was adopted by the Sub Saharan African Challenge Program (SSA CP) and implemented in eight different countries. The core of this approach is the development of Innovation Platforms (IPs), which can be described as an informal coalition and alliance of conventional agricultural research and development actors. Using the semi experimental data collected in this context, I could investigate the important role of social capital in different contexts. The second type of initiative is implementation of sustainable

certification schemes through group-based experimental learning approaches. I investigate four sustainable coffee projects in Vietnam, of which two adopted the interactive Farmer Field School training approach. The data of these four projects allow me to verify some of the conclusions in a different context and for a different development initiative.

In chapter 3, I use baseline data from the IAR4D initiative to explore the association between different forms of social capital and uptake of various agricultural innovations, for a sample of 2500 households in seven countries in SSA. I find that structural bridging social capital is associated with more extensive adoption of agricultural innovations. This result is true for the pooled model as well as for four of the seven country models. This form of social capital captures agriculture-related links creating access to knowledge and resources and is considered an important dimension of economic development. I find a negative association between cognitive bonding social capital and the innovation index. This finding could represent a potentially harmful side of social capital in terms of agricultural innovation.

In chapter 4, I investigate the impact of IAR4D on social capital. I narrow my focus on the border region between Rwanda, Uganda and the DRC. Because the SSA CP data set consist of randomized data of participating and non-participating villages, before and two years after implementation, I can investigate the impact of the program. Many participatory projects in rural Africa are efforts to enhance development indirectly by promoting cooperation in formal or informal networks, and by encouraging trust and norms of behaviour towards mutually beneficial action. But it remains unclear whether external interventions can actually influence social capital, especially in the short term. I show that IAR4D has had a positive impact on structural bridging social capital in DRC and Uganda. There was no impact on structural bridging social capital in Rwanda, or on the other dimensions of social capital. Finally, I showed that traditional agricultural extension has been less successful in increasing structural social capital than IAR4D.

In chapter 5, I use data from a survey I conducted among IP coordinators to measure the extent to which IPs were implemented according to the principles of IAR4D across the three sub regions. Linking these data to the main survey data, I find that the extent to which IPs were implemented according to IAR4D principles is associated with the success of IAR4D in increasing the level of household food security, although not through increased adoption of agricultural innovation or increased levels of social capital at household level. Looking at the sub-components of these principles, especially involvement of IP stakeholder is crucial. Tentative results suggest that this involvement is higher in communities with a higher

level of education, a higher percentage of female headed households, and a higher level of village social capital.

In chapter 6, I analyse how different indicators used to represent social capital are related in the border region between Rwanda, Uganda and the DRC. I focus on the relationship between various indicators of trust, an important component of cognitive social capital, and group membership, an important component of structural social capital. The indicators used are based on questions I added to the follow up survey of the SSA CP in 2010. I find that different indicators of trust and group membership cannot be empirically captured by an overarching social capital factor, and are not even necessarily associated to each other.

In chapter 7, I present evidence that the relationship between social capital and agricultural innovation is not only evident for the IAR4D approach, but also for a different development initiative in a different context: sustainable coffee certification in Vietnam. I use data collected among 240 randomly selected project participants and 150 comparable farmers that did not participate in the projects. I focus on the role of bonding and bridging cognitive social capital, defined as trust. I find a significant positive relation between trust and the uptake of sustainable agricultural training practices. This relationship mostly results from high levels of bridging trust, and is even higher in combination with high levels of bonding trust. I also find tentative evidence that participation in the sustainable coffee projects positively influenced bonding trust in one project whereas it negatively influenced bridging trust in another project.

In chapter 8, I give an overview of the three main findings. First, social capital is associated with agricultural innovation. Second, development initiatives can influence social capital. Third, the existing level of social capital is associated with the success of development interventions. However, the effect was not necessarily positive and depends greatly on the dimension of social capital.

I also present several implications for policy. First, stimulating social capital, especially bridging social capital, may be a natural leverage point for policy makers to promote agricultural development. Second, increased levels of social capital can indeed be an outcome of development initiatives, either intentionally or not. At the same time, I show that this impact requires specific efforts and is not necessarily positive. The third implication is that social capital matters for the success of certain development initiatives, either as a source of heterogeneous implementation or impact. Fourth, it is vital to take into account the multi-dimensional nature of social capital and the fact that these dimensions might have different relations to agricultural innovation and development initiatives. Combined these implications

mean that indicators of social capital should be included in the design and evaluation of agriculture-related development initiatives.

Finally, I give suggestion for future research. First, to further unravel the chains of causation between different dimensions of social capital, agricultural innovation, and development initiatives. Second, to validate the indicators and indices of social capital using experimental games, more advanced survey questions, or better embedding them in existing theories. A third area of future is to advance in the measurement of innovation as a truly interactive and participatory process. Fourth, to address whether the importance of social capital, as a catalyst for success or as an outcome variable, depends on the nature of the development initiatives or the context in which it is implemented. Finally, research yet has to address the long-run effect of development initiatives on social capital.

Samenvatting

In dit proefschrift laat ik zien dat sociaal kapitaal een belangrijke rol speelt bij de evaluatie van ontwikkelingsinitiatieven gericht op agrarische innovatie. Vanuit een innovatiesysteem perspectief, waarin innovaties voortkomen uit de integratie van kennis van verschillende belanghebbenden, zijn sociaal kapitaal en agrarische innovatie van nature gekoppeld. In hoofdstuk 1 formuleer ik de drie onderzoeksvragen waarop dit proefschrift is gebaseerd. Ten eerste, hoe zijn sociaal kapitaal en agrarische innovatie aan elkaar verbonden? Ten tweede, kunnen ontwikkelingsinitiatieven agrarische innovatie verhogen door het stimuleren van sociaal kapitaal? Ten derde, is het oorspronkelijke niveau van sociaal kapitaal belangrijk voor het wel of niet slagen van deze initiatieven in het verbeteren van agrarische innovatie? Deze vragen gelden met name voor het toenemende aantal programma's en projecten die de begunstigden betrekken in het ontwerp, het beheer en de besluitvorming.

In hoofdstuk 2 ga ik in op de belangrijkste concepten achter dit proefschrift waaronder sociaal kapitaal, hoe sociaal kapitaal zich verhoudt tot ontwikkelingsinitiatieven in de agrarische sector en hoe het kan worden gemeten. Ik definieer sociaal kapitaal in de brede zin als de participatie van individuen in formele en informele netwerken, de normen die binnen deze netwerken gelden en het vertrouwen van deze individuen binnen en buiten deze netwerken. Deelname aan netwerken is structureel sociaal kapitaal, terwijl normen en vertrouwen binnen en tussen deze netwerken cognitief sociaal kapitaal is. Ik onderscheid vier dimensies van sociaal kapitaal: structureel verbindend, structureel overbruggend, cognitief verbindend en cognitief overbruggend. In dit proefschrift is het onderscheid tussen verbindend en overbruggend sociaal kapitaal gelijk aan het onderscheid tussen sociaal kapitaal binnen en buiten het dorp. Agrarische innovatie wordt gedefinieerd in termen van verbeterd grond- en gewasbeheer, een belangrijk onderdeel van agrarische innovatie voor kleinschalige producenten.

In hoofdstuk 3 tot 7 presenteer ik empirisch onderzoek naar de relatie tussen sociaal kapitaal, agrarische innovatie en twee soorten ontwikkelingsinitiatieven. Het eerste initiatief is de implementatie van een aanpak genaamd "Integraal Landbouwkundig Onderzoek voor de Ontwikkeling" (Integrated Agricultural Research for Development (IAR4D)). IAR4D werd door het Sub Saharan African Challenge Program (SSA CP) in acht verschillende landen geïmplementeerd via het Forum van Lanbouwkundig Onderzoek in Afrika (Forum of Agricultural Research in Africa (FARA)). De kern van deze aanpak is de ontwikkeling van

Innovatie Platforms (IP's). IPs kunnen worden omschreven als informele coalities en allianties van conventionele landbouwkundig onderzoeks- en ontwikkelingspartners. Met behulp van de semi-experimentele implementatie van de IPs en de daarbij behorende dataverzameling, kon ik de belangrijke rol van sociaal kapitaal in verschillende contexten onderzoeken. Het tweede soort initiatief is de implementatie van duurzame koffieprojecten door middel van experimentele leermethoden. Ik onderzoek vier koffieprojecten in Vietnam, waarvan twee de interactieve Farmer Field School trainingsaanpak gebruikten. De analyses van deze projecten stelt mij in staat een aantal van de conclusies van IAR4D te verifiëren met ander ontwikkelingsinitiatieven en in een andere context.

In hoofdstuk 3 gebruik ik de gegevens uit de nulmeting van het IAR4D initiatief voor een steekproef van 2500 huishoudens in zeven landen in SSA om de relatie tussen de verschillende vormen van sociaal kapitaal en het gebruik van diverse agrarische innovaties te verkennen. Ik kan vaststellen dat structureel overbruggend sociaal kapitaal is gerelateerd aan meer agrarische innovaties. Dit resultaat geldt voor het model geschat over de totale steekproef evenals de schatting van vier van de zeven landmodellen. Deze vorm van sociaal kapitaal, gemeten als de landbouw gerelateerde connecties, wordt beschouwd als een belangrijke dimensie van economische ontwikkeling doordat het leidt tot toegang tot kennis en andere middelen. Ik stel vast dat er een negatieve relatie is tussen cognitief verbindend sociaal kapitaal en landbouwkundige innovatie. Deze bevinding laat zien dat er een potentieel schadelijke kant is van sociaal kapitaal op het gebied van agrarische innovatie.

In hoofdstuk 4 onderzoek ik de invloed van IAR4D op sociaal kapitaal. Ik verklein mijn focus op het grensgebied tussen Rwanda, Oeganda en de Democratische Republiek van Congo (DRC). Omdat de SSA CP dataset bestaat uit gegevens van deelnemende en niet deelnemende dorpen, vóór en twee jaar na de implementatie, kan ik de impact van het programma onderzoeken. Veel participatieve projecten in landelijk Afrika richten zich op het bevorderen van wederzijds voordelige samenwerking en onderling vertrouwen. Maar blijft het onduidelijk of externe interventies hier daadwerkelijk aan bij kunnen dragen, met name op de korte termijn. Ik laat zien dat IAR4D in de DRC en Oeganda een positieve impact heeft gehad op structureel overbruggend sociaal kapitaal. Er was geen impact meetbaar op structureel overbruggend sociaal kapitaal in Rwanda, of op de andere dimensies van sociaal kapitaal. Tot slot concludeer ik dat de traditionele landbouwvoorlichting minder succesvol is in het bevorderen van structureel sociaal kapitaal dan IAR4D.

In hoofdstuk 5 gebruik ik de gegevens van een enquête die ik heb uitgevoerd onder de coördinatoren van de IPs om te meten in welke mate de IP's werden uitgevoerd in overeenstemming met de principes van IAR4D. Door deze gegevens te koppelen aan de gegevens uit de SSA CP dataset, concludeer ik dat de mate waarin de IPs zijn geïmplementeerd volgens de IAR4D principes verband houdt met het succes van IAR4D in het verhogen van het niveau van voedselzekerheid op huishoudniveau. Echter is er niet vastgesteld dat dit effect voortkomt uit de invoering van agrarische innovatie of het verhoogde niveaus van sociaal kapitaal. Er zijn voorzichtige aanwijzingen dat de intensiteit van betrokkenheid, een belangrijk onderdeel van de IAR4D principes, deels kan worden verklaard door het oorspronkelijke niveau van sociaal kapitaal op dorpsniveau.

In hoofdstuk 6 analyseer ik hoe de verschillende indicatoren die gebruikt worden om sociaal kapitaal te meten aan elkaar gerelateerd zijn in het grensgebied tussen Rwanda, Oeganda en de DRC. Ik focus op de relatie tussen de verschillende indicatoren van vertrouwen, een belangrijke component van cognitieve sociaal kapitaal, en deelname in een groep, een belangrijke component van het structurele sociaal kapitaal. De indicatoren zijn gebaseerd op de vragen die ik heb toegevoegd aan het vervolg onderzoek van de SSA CP in 2010. Ik constateer dat verschillende indicatoren van vertrouwen en deelname in groepen niet empirisch kunnen worden ondervangen door een overkoepelend sociaal kapitaal "factor" en dat ze zelfs niet per se verband met elkaar houden.

In hoofdstuk 7 presenteer ik bewijs dat de relatie tussen sociaal kapitaal en agrarische innovatie niet alleen evident is voor de IAR4D aanpak, maar ook voor een andere ontwikkelingsinitiatief in een andere context: duurzame koffiecertificering in Vietnam. Ik analyseer gegevens van 240 willekeurig geselecteerde projectdeelnemers en 150 vergelijkbare boeren die niet deelnemen aan de projecten. Ik focus op de rol van bindend en overbruggend cognitief sociaal kapitaal, geoperationaliseerd als vertrouwen. Ik stel vast dat er een significant positief verband is tussen vertrouwen en de introductie van duurzame agrarische praktijken. Deze relatie komt met name voort uit een hoge mate van overbruggend vertrouwen, vooral in combinatie met een hoge mate van bindend vertrouwen. Ik vind ook voorzichtige aanwijzingen dat deelname aan één van de projecten een positieve invloed heeft gehad op bindend vertrouwen, terwijl het een negatieve invloed heeft gehad op overbruggend vertrouwen in een ander project.

In hoofdstuk 8 geef ik een overzicht van de drie belangrijkste bevindingen. Allereerst is sociaal kapitaal verboden met agrarische innovatie. Ten tweede kunnen

ontwikkelingsinitiatieven sociaal kapitaal beïnvloeden. Ten derde is het bestaande niveau van sociaal kapitaal een factor in het succes van ontwikkelingsinitiatieven. De effecten zijn echter niet per definitie positief en afhankelijk van de dimensie van sociaal kapitaal.

Ik opper ook verschillende implicaties voor programma's en beleid. Ten eerste kan het stimuleren van met name overbruggend sociaal kapitaal een natuurlijke aangrijpingspunt zijn voor beleidsmakers om agrarische ontwikkeling te stimuleren. Ten tweede kunnen ontwikkelingsinitiatieven, gepland of ongepland, leiden tot meer sociaal kapitaal. Tegelijkertijd laat ik zien dat dit effect specifieke inspanningen vereist en niet noodzakelijkerwijs positief is. De derde implicatie is dat sociaal kapitaal belangrijk is voor het succes van bepaalde ontwikkelingsinitiatieven, als een bron van heterogene implementatie of impact. Ten vierde, het is essentieel om rekening te houden met het multidimensionale karakter van sociaal kapitaal en het feit dat deze dimensies verschillend zijn verbonden met agrarische innovatie en ontwikkelingsinitiatieven. Tezamen betekenen deze implicaties dat het goed zou zijn als de indicatoren van sociaal kapitaal worden opgenomen in het ontwerp en de evaluatie van landbouw gerelateerde ontwikkelingsinitiatieven.

Tot slot geef ik suggesties voor toekomstig onderzoek. Ten eerste, het verder ontrafelen van de oorzaak-en-gevolgketen tussen verschillende dimensies van sociaal kapitaal, agrarische innovatie en ontwikkelingsinitiatieven. Ten tweede, het valdieren van de indicatoren van sociaal kapitaal met behulp van experimentele onderzoeksmethoden, meer geavanceerde enquêtevragen, of door het integreren met bestaande theorieën. Ten derde, het meten van innovatieprocessen als daadwerkelijk interactieve en participatieve processen. Ten vierde zou toekomstig onderzoek zich kunnen richten op de vraag hoe het belang van sociaal kapitaal, als katalysator voor succes of als een uitkomst variabele, afhankelijk is van de aard van de ontwikkelingsinitiatieven of de context waarin het wordt geïmplementeerd. Tot slot is er nog volop behoefte om de langetermijneffecten van ontwikkelingsinitiatieven op sociaal kapitaal te onderzoeken.

Acknowledgement

I have finished it, or almost. The only thing that remains is writing this: the acknowledgements. Not the most complicated part of finishing, one would say. Yet at his stage, one day before the deadline, it seems to require more thought than some of the analyses I have conducted throughout the course of my PhD. And the consequences of making a mistake seem equally dire. Whom to thank for having been able to complete this wonderful piece of work, and all that came with it: the endurance, the loneliness, the creativity, the "what does it matter?" and "why am I doing this?" feeling, the inspiration and making the courageous decision to start in the first place.

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After beginning, it is a matter of not giving up, and going ahead. At this stage there are many people I would like to thank and some I will probably forget. A very special thanks goes to Marrit; my supervisor. Marrit, I have always appreciated your honest, swift and pragmatic feedback. Especially in the last period of my PhD your support meant a lot to me, and I would not have delivered such a fine thesis without your support.

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Finally, mom and dad, I would never have decided to follow and fulfill my dreams, ambitions and crazy ideas (and this PhD thesis is definitely one of them) if it weren't for you. Kelin and Ailis you have made every day of my life as a PhD candidate a gift since the moment you were born! And Joren, my dear husband, without a doubt you deserve the biggest acknowledgement of all. As always, you will be the one reading through these very acknowledgements until late this evening, and assure me they are fine- in fact perfect; assure me life will go on, even if I forget someone; and assure me I can do it: actually finish it!

About the author

Fédes Cersan van Rijn was born on August 25, 1985 in Harlingen, the Netherlands. In 2002 she finished her secondary school at the Drachtser Lyceum in Drachten. The same year she started the study International Business and Management studies at the Hanze University of Applied Sciences in Groningen. In 2006 she graduated with a major in marketing and a minor in finance. Her bachelor thesis focused on the feasibility of a sustainable ginger supply chain from Tanzania.

From 2006 until 2008 she studied International Development Studies in Wageningen with a focus on rural economics. In this period she also conducted an internship at the ministry of Foreign Affairs and conducted field work for her MSc thesis in Peru. The thesis focused on the evaluation of a sustainable coffee project.

In 2009 Fédes obtained a scholarship from the Wageningen School of Social Sciences and started as a PhD candidate at the Development Economics Group. In this period she followed various economic, development and econometric courses and presented her work at various conferences. She also conducted various consultancy projects on the impact of coffee certification in various countries.

Since January 2014 Fédes started working as a researcher at the Agricultural Economic Institute of Wageningen University (LEI-WUR) in The Hague, the Netherlands.

Fédes Cersan van Rijn
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Name of the learning activity	Department/ Institute	Year	ECTS*
A) Project related competences			
The Economic Institutions of Agriculture, Food and Rural Areas	WASS	2009	1.5
Advanced Econometrics	WUR	2009	6
Panel data analysis in micro economics - methods and applications	WASS	2009	1.5
Advanced Microeconomics	WUR	2010	6
Behavioural Economics	NAKE	2010	6
Social Network Analysis	NAKE	2011	3
B) General research related competences			
Introduction course	WASS	2009	1.5
'Impact Assessment in the Sustainable Livelihood Framework'	Impact Evaluation Conference, Amsterdam Institute for International Development	2010	1
Techniques for Writing and Presenting a Scientific Paper	WGS	2010	1.2
'Social capital and agricultural innovation in Sub Saharan Africa'	CSAE Conference - University of Oxford	2011	1
'The impact of agricultural extension services on social capital'	MOPAN Conference - WUR	2012	1
'The impact of agricultural extension services on social capital'	Brown Bag Seminar - International Food Policy Research Institute	2012	1
'Trust and sustainable coffee projects'	EAAE Conference - Ghent University	2013	1
C) Career related competences/personal development			
Personal Assessment	WASS / Meijer & Meijaard	2010	0.3
Voice and Presentation Skills	WASS / Voice Matters	2012	0.4

Theory and practice of development (teaching)	WUR	2012	0.25
Methods, Techniques and Data Analysis for Field Research A (teaching)	WUR	2010/12	1.5
Academic Consultancy Training (supervising)	WUR		0.75
Career Assessment	WASS / Meijer & Meijaard	2013	1.6
Economics A (teaching)	WUR	2013	0.75
Total			**37.25**

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

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