

Ambidexterity and mobile hubs as the interface for orchestrating multi-level innovation networks and fostering capabilities in innovation processes:

Evidence from agricultural netchains in Sub-Saharan Africa



Silvia Andrea Pérez Perdomo

Propositions

1. Ambidextrous management requires governance capabilities for managing structural, contextual and temporal challenges.

(this thesis)

2. Mobile hubs are important for orchestrating multi-level innovation networks.

(this thesis)

3. Facebook and YouTube-platforms are communication spaces for stimulating social movements in civil society.

4. War triggers innovation through 'creative destruction', resulting in new ways of doing things.

5. Global challenges are the 'new commons' that need ambidextrous management.

6. Research has limits, but learning is unlimited.

Propositions belonging to the thesis, entitled

Ambidexterity and mobile hubs as the interfaces for orchestrating multi-level innovation networks and fostering capabilities in innovation processes: Evidence from agricultural netchains in sub-Saharan Africa

Silvia Andrea Pérez Perdomo

Wageningen, 20th of March 2018.

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Thesis

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My PhD has been a very difficult journey, but I hope it is an inspiring one for others who want to endure it and learn from it.

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Chapter 1. Introduction

1.1 Family farmers and innovation in Sub-Saharan Africa

Despite improvements over the past three decades in fighting hunger and famine there are still 795 million undernourished people, the vast majority of whom live in developing regions of the world (FAO et al., 2015). Even within the developing world there are large disparities; for example between 1990-1992 and 2014-2016 the number of undernourished people decreased in Latin America but increased in Sub-Saharan Africa, with particular problems in eastern and central Africa (FAO et al., 2015).

Family farming is responsible for the vast majority of global agricultural production and family farms will need to play an important role to supply a projected 60% increase in demand for agricultural products by 2050 (FAO, 2014). However, labour productivity is low and poverty levels are high among family farmers. As a consequence, 70% of family farmers—mainly in developing countries—are food insecure and make up a large proportion of the world's food insecure people. In order to reach the global goals of no poverty and zero hunger (United Nations, 2015) the agricultural sector in many developing countries, especially in Sub-Saharan Africa, requires urgent innovation.

Innovation is considered here as a cyclical process that develops new products and services to respond to specific needs (Nooteboom, 2000). Innovation in the agricultural sector of Sub-Saharan African countries will need to address the issues of land and labour productivity, natural resource management, linkages to input and output markets and the distribution of benefits of marketed agricultural products (FAO, 2014, Jayne and Ameyaw, 2016). Innovation also incorporates the organisation of the multiple actors that constitute the agricultural sector (FAO, 2014), these actors form networks which as a whole can be considered as an 'innovation system' (World Bank, 2007). Family farmers in Sub-Saharan Africa often lack access to information, knowledge and other resources necessary for them to develop capabilities to work collectively

and to engage in business opportunities. Therefore, family farms need to join collaborative ‘innovation networks’ as a way to optimise the use of resources and to strengthen their organisational, production, technological, financial, and entrepreneurial capabilities. Innovation networks have always existed but have only recently been theorised as a ‘new form of organisation within knowledge production for the exploration of synergies and the exploitation of complementarities’ (Pyka and Küppers, 2002) in an innovation process. Exploration and exploitation refer to different ways of learning, but the terms have evolved into looking at different ways of coordinating people in organisations, and different ways of managing the timing of an innovation process (March, 1991, O'Reilly and Tushman, 2008, Cantarello et al., 2012). Family farmers might explore different livelihood options, but are often unable to fully exploit those options and cannot convert their capabilities into tangible and economic benefits, remaining in a cycle of poverty.

The open innovation paradigm, with expertise sought from outside previously impermeable institutions (Chesbrough, 2003, Omta and Fortuin, 2013), has become prevalent in many agricultural innovation systems of Sub-Saharan Africa as a result of disinvestment in agricultural institutions resulting from structural adjustment policies in the 1980's (Subramanian et al., 1994, Goldin and Winters, 1992). Structural adjustment policies often tied aid to the privatisation of the delivery of services in sub-Saharan Africa. With a weak private sector many non-governmental organisations—both international and local—were founded or expanded to fill the gap (Bratton, 1989). Systems of innovation therefore changed from centralised systems of national agricultural research institutions and extension services to a variety of service providers, with the entry of many new research and development stakeholders (Anandajayasekeram, 2011). In Uganda for instance, decentralisation reform has transferred the coordination of developmental projects from central to local governments. The former top-down approach in Uganda has changed to a bottom-up approach that has to be coordinated with community

participation (Nkabulo, 2007). Globalisation has also contributed to open innovation, with greater mobility of people around the world, more open markets, and more possibilities for knowledge to spread, aided by information and communication technologies. Over the same period innovation in agricultural research has evolved from the linear model in which ‘innovations’ were conceived as technologies to be transferred and adopted, to agricultural knowledge and information systems (Engel and Salomon, 1997 cited in Röling, 2009) and further as innovation systems (Röling and Engel, 1991). In the innovation systems paradigm innovation is defined as a multi-stakeholder process, in which stakeholders work to create synergy and complement each other for concerted innovation action (Röling, 2009). In open innovation processes, innovation networks organise at multiple levels: local, national, regional, international and even virtually, and within value chains to form ‘netchains’ (Lazzarini et al., 2001). Netchains include farmers, researchers, traders, transporters, processors, finance institutions, international non-governmental organisations.

1.2 Innovation networks tackling food insecurity and poverty of family farmers in sub-Saharan Africa

Over the past decade there have been an increasing number of initiatives that are testing strategies or intervention approaches to enhance farmers’ capabilities (See case studies of CFS, 2015). These initiatives involve different configurations and levels of innovation networks, and also aim to foster some capabilities of family farms.

Some initiatives seek to develop organisational and knowledge capabilities like in Farmer Field School networks, or Village Information and Communication Centers (Pérez Perdomo et al., 2009), in which farmers have the opportunity of learning by doing and sharing knowledge. In these initiatives farmers join “communities of practice” (de Jager et al., 2009, Pérez Perdomo et al., 2009, Nonaka and Takeuchi, 1995) as part of local small innovation networks.

Initiatives based on the use of information and communication technologies (ICTs) that combine information systems using internet platforms and mobile phones, might foster information and communication capabilities of farmers to share market information and prices of commodities. Mobile phones are facilitating linkages of farmers to local, national and international markets. In the Philippines, Uganda, South Africa and Kenya¹ farmers get information by voice and text messages on markets and prices, daily or seasonal weather forecasts, the production of pesticides and even use internet for sending money to relatives. These new ways of sharing knowledge and social interaction mediated by the use of ICTs facilitate more participative and open approaches for fostering capabilities for innovation. While an increasing number of farmers have access to ICTs due to ubiquity of media and access to the technology, there are still factors that limit their use; such as a limited knowledge in the use of ICTs, costs of services of internet, and language limitations (Pérez Perdomo, 2003, Parkinson, 2005).

Other initiatives are more oriented to developing family farms as businesses. These initiatives involve the making of formal arrangements along the value chain to link farmers to markets. A simple arrangement might be contract farming (e.g. Coulter et al., 1999), but a number of initiatives have taken advantage of niche international markets for high value products such as organic horticulture (KIT and IIRR, 2008, KIT et al., 2006). These value chain initiatives require very effective organisational arrangements to take advantage of economies of scale, and to meet stringent food safety and production standards (Vellema and Boselie, 2003, Ton et al., 2007). These quantity and quality standards are hardly ever met by smallholder family farmers that are not organised in producer organisations. Therefore, these initiatives have focussed on strengthening the organisational and entrepreneurial capabilities of producer groups using

¹ http://www.economist.com/surveys/displaystory.cfm?story_id=14483848

approaches like participatory diagnosis, participatory market research, farmer participatory research and agro-enterprise development.

Value chains can be also organised in multi-level networks as netchains (Lazzarini et al., 2001), with flows of resources and information at various levels. These flows include new technologies from research organisations to be adopted by farmers, agricultural products from farmers to traders, and internal and external knowledge of multiple organisations. For these highly complex systems, initiatives have attempted to link farmers with research and development partners, private sector, and other civil society stakeholders in multi-stakeholder platforms (Shepherd, 2007, Lightfoot and Scheuermeier, 2007, Prasad and Hambly, 2009, Devaux et al., 2007, KIT et al., 2006, Kaaria et al., 2008, Sanginga et al., 2004). The Papa Andina Regional Initiative in South America tests two approaches (Participatory Market Chain Approach and Stakeholder Platforms) that make commercial, technological, organisational and institutional arrangements for innovation. Multiple capabilities for innovation are fostered using approaches like participatory market analysis, community visioning, diagnosis and selection of technology and marketing options. Similarly, in the African context, an approach called Integrated Agricultural Research for Development (IAR4D) has been developed as a way of engaging multiple stakeholders in different innovation network levels (local, national, regional, international and virtual). Multi-stakeholder Innovation Platforms (MSIPs) are a key component of IAR4D. The arrangements made in these MSIPs are facilitated by a diversity of stakeholders. This facilitation allows the exchange of internal and external knowledge and other resources of organisations, and fosters multiple capabilities—technical, social and institutional—of the farmers and other stakeholders in the innovation network.

The diverse stakeholders that are common in netchain initiatives can present various ‘interface problems’ that require careful management to ensure effective outcomes of the innovation

process. Stakeholders are often separated by geographical distance, priorities, motivations, capabilities, timeframes, education and cultural backgrounds. Some stakeholders might be interested in promoting technological innovations; others in prioritising process innovation and learning; while others are more interested in profit. When there is a diversity of types of stakeholders (such as smallholder family farmers, traders, processors, researchers and other service providers) some might be well organised and others might not. Problems might also arise in netchains where some stakeholders come from countries where policies are clear and where others come from countries where there are no policies. All these interface problems affect the process of developing capabilities of farmers for innovation, particularly if there is also no continuity of efforts. Moreover, when there is a diversity of initiatives with different approaches or goals but which include the same R&D actors and other civil society stakeholders it can be overwhelming for farmers if the process is not managed effectively. It is clear that an open innovation process that intends to tackle global challenges such as food insecurity and poverty needs the facilitation of diverse stakeholders at multiple levels.

1.3 Ambidexterity for the management of exploration and exploitation in an open innovation process

Innovation networks that aim to help family farmers improve productivity and increase incomes need to manage effectively some potentially contradictory dynamics and interface problems incurred in the innovation process. Stakeholders can have different and even competing functions and motivations, which can hamper the coordination of the innovation process. Some stakeholders might prioritise the informal exploration of new methods and join small innovation networks, focusing on fostering learning in communities of practice. Other stakeholders might prefer joining larger innovation networks to consolidate more formal arrangements (as a producer organisation to do contract farming, business network, adoption of a technology) and ‘exploit’ more specialised capabilities (e.g. producing to high quality standards). Others might be

interested in joining multi-level and sometimes international innovation networks for collectively tackling complex challenges.

The variety of approaches and exchange of resources in multi-level networks requires coordination, which represents various managerial challenges. Management and innovation theory provides a solution with a high order capability for the management of exploration and exploitation—ambidexterity.

Exploration and exploitation represent the complexity of contradictory dynamics of structure, time and context that in practice need simultaneous management (Figure 1.1a). Exploration and exploitation are concepts used in management and innovation theory to explain different but complementary multidimensional dynamics that take place over the ‘cycle of innovation’ (Gilsing and Nooteboom, 2006). These dynamics need to be managed according to the challenge being tackled at particular stages of the innovation cycle (Figure 1.1b). For instance, action plans for managing the timing of the process are needed for short, medium and long-term trajectories. Likewise, innovation to tackle development challenges like food security and poverty needs both local and global efforts.

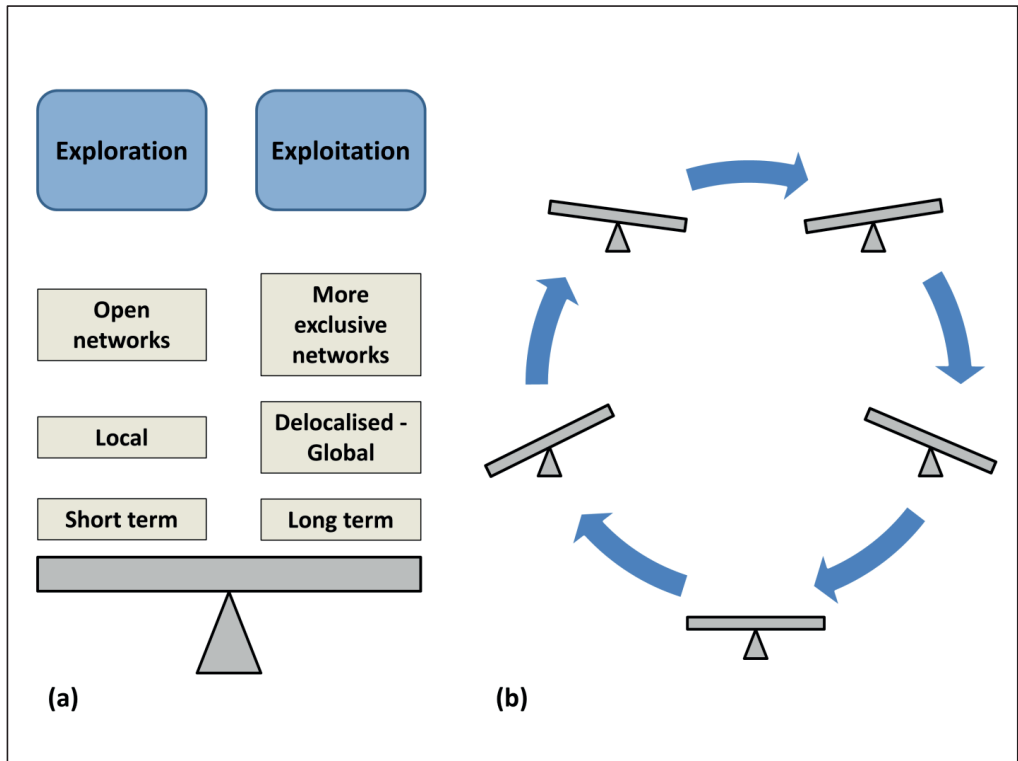


Figure 1.1 Examples of contradictory dynamics (exploration and exploitation) to manage in an innovation process. Source: Silvia Andrea Pérez Perdomo

The literature of ambidexterity describes structural, contextual and temporal solutions for managing exploration and exploitation in organisations (Cantarello et al., 2012).

Structural solutions (i.e. how to socially organise exploration and exploitation) is the area of research that has most captured the attention of scholars, given its demonstrated importance on the performance and outcomes of organisations. However, in the open innovation paradigm, networks emerge as a new unit of analysis, for instance, with roles of specialised organisations that foster social innovation through regional networks (Ferrary, 2011). Therefore, management of structural dynamics through different governance mechanisms for exploration and exploitation becomes not only important for creating new products and services and better economic performance in firms, but also for better performance of multi-level innovation

networks. As pointed out by Agterberg et al. (2010), there is a general idea of self-organisation of networks, which needs a counterweight. This research proposes that although innovation networks have some dynamics of self-organisation, some degree of formal management is needed. Management and leadership play an important role for effectively achieving exploration and exploitation (Agterberg et al., 2010), which are also required in open innovation processes as presented in this thesis.

Contextual solutions consider the environment and boundaries for innovation and the associated multidimensional factors that can enable or hinder innovation processes. In the case of global challenges like food insecurity and poverty the boundaries of the environment of innovation are diverse and include not just geographical frontiers but also boundaries defined by cultural, political, institutional, and technological factors. Some stakeholders can have access to different resources and opportunities depending on their context. For instance poor infrastructure and underdeveloped institutions in some developing countries can undermine innovation.

Temporal solutions, meanwhile, take into account the timing of exploration and exploitation, and entail managing simultaneously activities that require short term, medium term and long term collaborative efforts. However, few studies have taken a longitudinal approach to observe these ways of management for exploration and exploitation in innovation processes, and particularly with evidence of networks in developing countries.

1.4 Outline of the thesis

This thesis addresses four research questions (Figure 1.2), following this introductory chapter each question is addressed in a separate chapter, with a final concluding chapter.

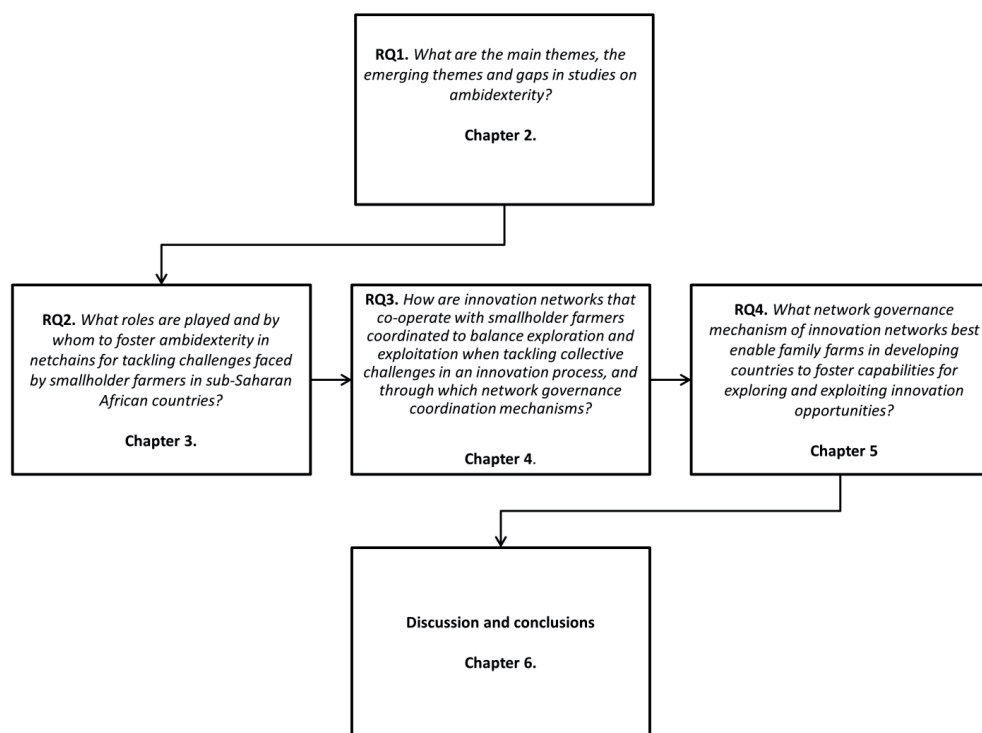


Figure 1.2. Research questions and chapters.

Chapter 2. Literature review on ambidexterity as a capability of innovation networks

The second chapter presents a systematic literature review on the topic of ambidexterity as a capability of innovation networks. The review highlights the different settings in which the concept of ambidexterity has been studied, the main and emergent themes, and the research gaps in the literature.

The review process is organised in four stages: Stage A describes the process of defining the literature universe using different functional operators, and the final sampling process. Stage B describes the coding of the selected literature, divided in two phases: (i) an exploration of different thematic areas using open coding, and (ii) a quantitative coding of the thematic areas. Stage C presents the results of the textual and quantitative analyses of the codes and quotations. Stage D presents the gaps in the literature and the conclusions.

This systematic review configures concepts that emerge from the literature to generate theory, following an inductive approach through an iterative analysis of concepts during all stages (Gough et al., 2012).

Chapter 3. Stakeholder roles and the emergence of collective roles

The third chapter describes and analyses the roles of stakeholders played collectively in innovation networks, concentrating on the collective roles that are necessary to exert ambidexterity as a dynamic and collective capability. I use a multi-case longitudinal design to observe the management of temporal, structural and contextual challenges and the roles played by stakeholders to tackle these, following Turner et al. (2013) suggestion of using qualitative approaches to study what roles are played and by whom to manage exploration and exploitation in complex settings, particularly for studies from emerging economies (Wei et al., 2011).

I select the case study method since it is appropriate for addressing research in which the researcher has little or no control of events (Yin, 2003). The case studies comprise six farmer groups as part of different levels of innovation networks collectively tackling challenges of potato (*solanum tuberosum*) netchains in south west Uganda, northwest Rwanda and eastern Democratic Republic of the Congo (DR Congo). The cases represent different configurations of innovation networks, involving certain layers of the netchain.

Innovation trajectories of each case are drawn using the event mapping schema of Van de Ven et al. (2008), tracking the roles played by stakeholders along the innovation process, to identify similarities and differences in roles. I also adjust the netchain analytical approach to track the roles played by stakeholders to manage structural challenges, facilitating organisational relationships (reciprocal, pooled and sequential ORs) for the horizontal, vertical or cross-network integration of the netchain.

Chapter 4. Orchestration of innovation networks and the need of longitudinal approaches to track their evolution in an innovation process

Chapter four presents multi-stakeholder innovation platforms as a type of multipurpose and multi-stakeholder cooperative incubator of innovation and entrepreneurship. In this chapter I adjust the netchain analytical approach to track the governance dynamics of innovation networks, using a longitudinal perspective.

Data collection is divided in two phases in order to capture changes of coordination mechanisms over time when facing complex challenges common in developing countries. Semi-structured interviews, observations and focus groups are conducted with key informant members of producer organisations and other stakeholders. Informants are asked retrospective questions related to ‘challenges of innovation’ or problems they faced. Questions also related to the general innovation challenges and contextual conditions for drawing the “environment” for innovation. Then a *participatory mapping of the evolution of innovation networks* is made for tracking each innovation trajectory using the event mapping schema of Van de Ven et al. (2008). On these trajectories I track inter-organisational relationships as indicators of governance mechanisms of innovation networks along the process. I adjust the analytical tools of netchain analysis (reciprocal, sequential and pooled inter-dependencies, (Lazzarini et al., 2001)). These organisational relationships represent different configurations of innovation networks (involving certain layers of the netchain), ways of integration (horizontal, vertical, cross-integration) and type of relationships (formal or informal for exploration and/or exploitation).

Chapter 5. Ambidexterity for effective outcomes of innovation networks in open innovation: multiple capabilities as indicators

The fifth chapter assesses the effectiveness of different governance mechanisms of multi-level networks on fostering network capabilities for exploration or/and exploitation over time.

Governance mechanisms represent different ways of management of networks in open

innovation processes. In particular I analyse the effectiveness of those governance mechanisms to foster capabilities of innovation networks that tackle the challenges faced by family farms in agricultural netchains. I test my hypotheses in the context of networks in agricultural netchains in Sub-Saharan African countries. I analyse statistically a panel dataset comprising 2,562 households from two household surveys conducted in Uganda, DR Congo and Rwanda in 2008/09 and 2010. A longitudinal design allows me to consider ambidexterity as a dynamic capability and to draw insights on how exactly innovation networks combine exploration and exploitation across family farms and across time (Simsek, 2009 pg. 889).

Chapter 6. This final chapter presents the main findings of this research and suggestions of further research.

Chapter 2. Ambidexterity as a dynamic capability of innovation networks to tackle challenges in innovation processes: A systematic literature review²

² Based on an article that was accepted for a second round of review as:

PÉREZ PERDOMO, S. A., FARROW, A., TRIENEKENS, J. H. & OMTA, S. W. F.

Ambidexterity as a capability to tackle managerial challenges in innovation processes: A systematic literature review. *Creativity and Innovation Management*.

2.1 Introduction

Ambidexterity is a human capability to conduct activities easily with both hands (Moreno Luzon and Valls Pasola, 2011). In management and innovation studies the term is used metaphorically to represent the ability of organisations to manage simultaneously exploration and exploitation (O'Reilly and Tushman, 2008). In 1976, Duncan introduced *organisational ambidexterity* as a capability to manage different organisational structures—what Kuckertz et al. (2010) refer to as *structural ambidexterity*. Subsequently many studies referred to the contribution of organisational ambidexterity to the performance of organisations. March broadened the concept of ambidexterity in 1991, presenting the concepts of exploration and exploitation not solely as different organisational structures, but also as different ways of learning in organisations. For Jansen et al. (2008) ambidexterity was a dynamic capability incorporating routines and processes with which organisations mobilise, co-ordinate and integrate dispersed contradictory efforts, and allocate, re-allocate, combine and recombine resources and assets across differentiated exploratory and exploitative units. Meanwhile, Andriopoulos and Lewis (2009) defined ambidexterity as the ability to excel at conflictive modes of innovation, i.e. incremental innovation for exploiting existing products and radical innovation for exploring new opportunities (see more definitions and perspectives in Cantarello et al. (2012)).

The great diversity of concepts, methodological approaches and areas of application has made the conceptualisation of ambidexterity something “with blurry connections in existing theories” (Durisin and Todorova, 2012). This diversity has exerted a counterproductive effect on building a theory of ambidexterity, making its operationalisation difficult (Cao et al., 2009a, Durisin and Todorova, 2012). As a consequence, the objective of this systematic literature review is to explore the state of the art on ambidexterity; the societal context of empirical studies, the main concepts, the units of analysis of studies, research gaps and to propose a research agenda.

We therefore, address the following research questions:

- I. In which journals, settings and countries and on which units of analysis have studies on ambidexterity been conducted?
- II. What are the main themes and the emerging themes in studies on ambidexterity?
- III. What gaps are found in the literature of ambidexterity?

The review process is organised in four stages: Stage A describes the process of defining the literature universe using different functional operators, and the final sampling process. Stage B describes the coding of the selected literature, divided in two phases: (i) an exploration of different thematic areas using open coding, and (ii) a quantitative coding of the thematic areas. Stage C describes textual and quantitative analyses. Stage D presents the gaps in the literature and the conclusions.

2.2 Methodology

This systematic review configured concepts that emerged from the literature to generate theory. Deliberately we did not fully define the key concepts in advance. We followed an inductive approach through an iterative analysis of concepts during all stages (Figure 2.1), which we interpreted and configured to create higher or meta-concepts (Gough et al., 2012).

The breadth of this systematic literature review was wide since ambidexterity has been applied in different scientific domains. Heterogeneity in systematic literature reviews is crucial (Gough et al., 2012) and our search was broad enough to obtain a wide range of concepts needed for a “sufficient coherent configuration” (Gough et al., 2012 pg. 61). Data sources were peer-reviewed identified articles and reviews. The source data were mainly qualitative since the aim was to identify the main concepts and gaps.

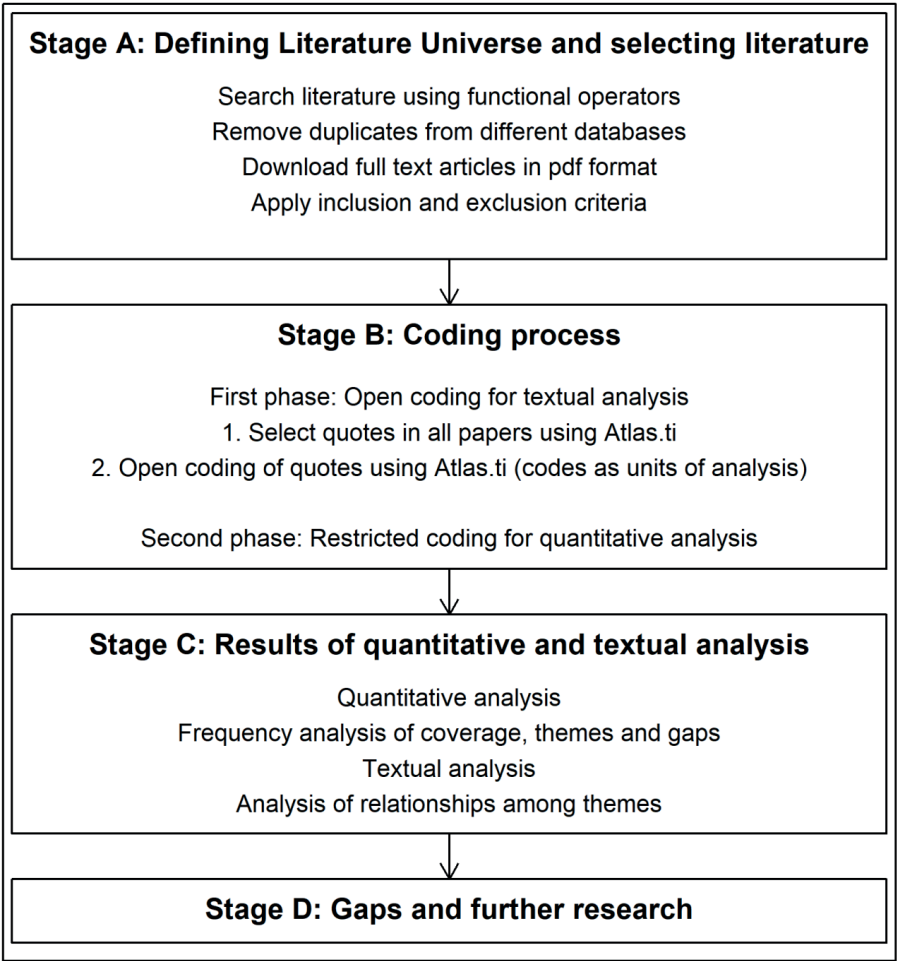


Figure 2.1. Stages of the systematic literature review

2.2.1 Stage A: Defining and selecting literature

Initially the literature of this review was peer reviewed articles, books and conference proceedings. We used two academic citation indexing and search services—“Scopus” and “Web of Science”.

Since our focus is on ambidexterity as a capability for innovation, we limited the search to the words AMBIDEXTERITY and INNOVATION, searching in all subject areas. We further

restricted searches to the social sciences, and to papers and reviews in English. This search resulted in 79 papers/reviews in Scopus; and 160 papers/reviews in Web of Science; a total sample of 239 papers/reviews. We exported the total sample of 239 papers/reviews to the Endnote citation management software, from which we identified 54 duplicates, resulting in a total number of 185 papers/reviews.

We refined the final selection of studies by applying a mixture of practical and subjective criteria (Table 2.1) to the broad selection of articles and reviews resulting from our final search. During the search process we applied the first two inclusion criteria (1 and 2), but excluded those studies which were not available as full text downloads (Table 2.1, criterion 5) since the next stage was textual analysis. Fourteen papers were excluded, resulting in a total of 171 full text articles which we downloaded and organised for the analysis of the qualitative data.

We found a further six replicates from these 171 articles (due to slight differences in the transcription of the citation—for instance in the initials of the author names—in Web of Science and Scopus), which we had not identified in the previous Endnote duplicate search.

We then applied the other inclusion and exclusion criteria (Table 2.1 criteria 3, 4, 6, 7, 8 and 9) to the resulting 165 articles and reviews. We excluded a further five because these were studies on physical ambidexterity, not ambidexterity as a social capability. The final sample therefore included 160 full text articles, of which four were literature reviews.

Table 2.1. Inclusion and Exclusion criteria

Inclusion criteria	Exclusion criteria
1. Timeframe: all years until 2013	5. Papers that are not available in pdf or full text electronic version
2. Papers or reviews in English	6. Papers that do not refer to social processes
3. Papers in which ambidexterity is the central topic, or it presents concepts or measurements related to it.	7. Papers without relation to social dynamics of ambidexterity
4. Papers about ambidexterity as a social capability only (in contrast to ambidexterity as a physical, or technological capability)	8. Papers about ambidexterity as a physical or technological capability that is not presented in relation to social dynamics of ambidexterity
	9. Papers about products or things that are not presented in relation to social dynamics of ambidexterity

2.3 Stage B: Coding process

2.3.1 First phase: Open coding for textual analysis

The open coding followed an explorative approach given that we were neither able to anticipate nor control the emergence of themes from the literature. We reviewed the 160 full texts of papers and reviews in detail, searching for concepts that related to ambidexterity. We applied open coding to preserve the diversity and heterogeneity of concepts in the literature. This process implied going backwards and forwards in the data, using the ‘quotations’ tool in the Atlas.ti software to mark specific paragraphs that mentioned a concept or contained more detailed information, such as the reported gaps or suggestions of further research. We created new codes in Atlas.ti or applied existing codes for each quotation resulting in 426 codes related to ambidexterity, and showed the reiteration of some concepts and some emerging themes.

We then allocated the codes to one or more of 15 general themes (Figure 2.2). We identified three main perspectives (contextual, structural and temporal), which are described in the literature of organisational ambidexterity (Nosella et al., 2012, Turner et al., 2013). Other themes resulted from our analysis of the network of codes and their novelty in the literature. An

additional theme included codes that referred to the identification of research gaps and suggestions of further research.

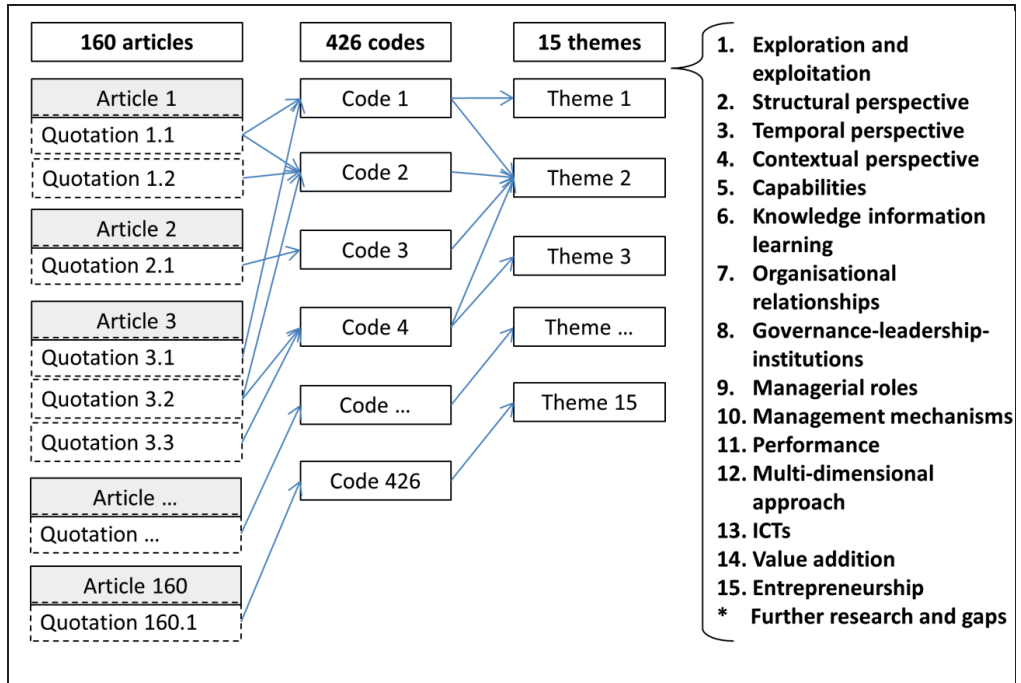


Figure 2.2. Allocation of codes and quotations to themes

2.3.2 Second phase: Restricted coding for quantitative analysis

We carried out a second phase of more restricted coding to measure systematically the concepts from the first phase of open coding. We coded each paper adding factual information about the document (such as year published, and journal name). We also coded the various societal levels in which studies were conducted. Therefore, in this second phase we included the productive sector and the names of the country or region of focus of empirical studies, and a code called ‘unit of analysis’ to classify those societal levels in which ambidexterity is studied. We used six societal levels: (1) individual; (2) household or team; (3) organisation or firm; (4) network of organisations; (5) specific industry or economic sector; and, (6) a mixture of these units.

Table 2.2. List of coverage and theme variables coded for each article in SPSS

Restricted coding variables	Coding
Title	Name
Author	Name
Journal	Name
Publication Year	Year
Countries	Name
Unit of analysis (Societal level)	1–6
Productive Sector	Name
Exploration and exploitation	0 / 1
Structural perspective	0 / 1
Temporal perspective	0 / 1
Contextual perspective	0 / 1
Capabilities	0 / 1
Knowledge information learning	0 / 1
Organisational relationships	0 / 1
Governance–leadership–institutions	0 / 1
Managerial roles	0 / 1
Management mechanisms	0 / 1
Performance	0 / 1
Multi-dimensional approach	0 / 1
Information and Communication Technologies	0 / 1
Value addition	0 / 1
Entrepreneurship	0 / 1

We stored the data in SPSS software, and derived statistics of the total number of articles per theme. We coded each paper for the same list of themes, each paper received a binary (0 or 1) value depending on whether the paper addressed that theme or not (Table 2.2).

For the further research and gaps we created a separate dataset comprising just those 112 articles that had mentioned gaps or the need for further research. We used all quotations and codes about gaps that were marked in the first phase of open coding to specifically address the research questions on gaps. We classified the types of gaps according to the following categories: (1) Structural, (2) Temporal, (3) Contextual, (4) Other suggested areas of research, (5) Performance, and (6) Managerial roles. We created the category (7)—Setting for future research—because some scholars pointed out the need for studies from emergent economies. Further categories were: (8) Governance, leadership and inter-organisational relationships, (9) Capabilities, (10) Learning and Knowledge, (11) Multi-dimensional approach and (12) Information and

Communication Technologies. For each paper we noted the gap as well as the method or approach that was suggested by the authors to address the gap.

2.4 Stage C: Results of quantitative and textual analyses

We present in this section the results of the quantitative and textual analyses, which will answer the first two research questions:

- I. In which sectors, settings, countries and at which levels have studies on ambidexterity been conducted?
- II. What are the main themes and the emerging themes in studies on ambidexterity?

2.4.1 Coverage of the literature

The coverage of this systematic literature review on ambidexterity and innovation was broad with studies published in 75 different journals from different scientific domains, which showed the wide relevance of the concepts. Nevertheless, journals specialising in management most often published studies on ambidexterity and innovation (Table 2.3).

Table 2.3. Frequency of articles in specific journals

Journal	Frequency
Journal of Management Studies	9
Management Decision	9
Strategic Management Journal	8
Journal of Product Innovation Management	7
Organization Science	7
R&D Management	6
Technovation	6
International Journal of Technology Management	5
Academy of Management Journal	4
Journal of Management	4
Journal of Operations Management	4
Journal of Strategic Information Systems	4
Long Range Planning	4
European Management Review	3
Strategic Organization	3
The International Journal of Human Resource Management	3
The Leadership Quarterly	3
58 other journals	Less than 3

2.4.2 Sector, Setting, Country and Societal level

The context in which the studies have been conducted is broad. In the open coding process, 75 codes and 266 quotations referred to empirical studies carried out in a variety of sectors. Studies were conducted mainly in large firms focussing on banking, pharmaceutical biotechnology, construction, manufacturing firms, and in firms that focus on technology-oriented ventures such as the optical disk, and the computer games industries. However, studies have extended and diversified to a broader range of sectors and settings, such as agriculture (Bedford, 2015), small and medium sized enterprises (SMEs) (Chang et al., 2011), supply networks (Narasimhan and Narayanan, 2013), projects (Li and Huang, 2013), universities (Chang et al., 2009, Tahar et al., 2011, Ambos et al., 2008), in health research (Oborn et al., 2013), hotels (Martinez-Ros and Orfila-Sintes, 2009) and in the context of the family (Koenig et al., 2013).

Other settings of research reflect new dynamics to manage exploration and exploitation in the context of innovation. Over the last decade, ambidexterity has gained importance in the context of developmental organisations and international cooperation for tackling global challenges (e.g. Agterberg et al. (2010), Schemeil (2013)).

The origin of studies was concentrated in high income economies like the United States, Germany and other European nations (Figure 2.3). Nevertheless, there was a broadening process of ambidexterity to settings in lower middle income economies like India, upper middle income economies like China or the case of international new ventures of multinational enterprises (Han and Celly, 2008) using managerial strategies across many countries (in Figure 2.3 as part of NA). The use of Information and Communication Technologies in the knowledge society is a contributor of such more globalised dynamics, which makes ambidexterity often a virtually

mediated managerial capability, like in innovation technology enabled innovations (Ashurst et al., 2012).

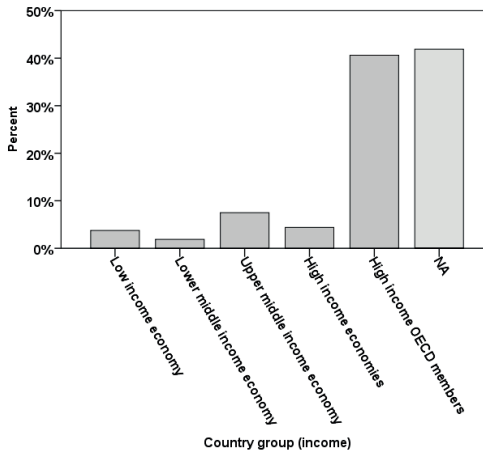


Figure 2.3. Countries of origin empirical studies (grouped by World Bank 2015 income groupings)³

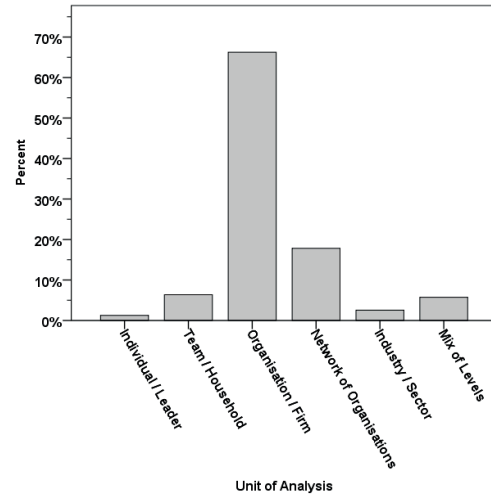


Figure 2.4. Unit of analysis of studies on ambidexterity

Regarding the unit of analysis of the studies, ambidexterity is a capability studied at multiple societal levels and different sectors (Figure 2.4). In general, we found that the majority of studies have been conducted at the level of the organisation (Raisch and Birkinshaw, 2008, Raisch et al., 2009, Nosella et al., 2012), but this is changing steadily towards more attention to network studies (Figure 2.4).

³ Low income economy - in the sample includes global studies, no study looked at a specific low-income economy country. Lower middle-income economy - in the sample includes India. Upper middle-income economy - in the sample includes China. High income economies - in the sample includes Taiwan. High Income economies (OECD) - in the sample includes USA.

2.4.3 Main and emergent themes

Table 2.4 presents the percentage of papers that mentioned the main and the emerging new themes that have been identified in the literature, and shows the evolution of the literature over time. We observed an increased interest of scholars in ambidexterity particularly in the period between 2008 and 2015. We grouped the themes by the main constructs identified in the literature of ambidexterity. In the following sections we elaborate on these results.

Table 2.4. Percentage of papers covering main and emergent themes and number of papers covering each theme per period

Main and emerging themes	% of papers covering theme	Number of papers covering each theme per period		Total
		1999-2007	2008-2015	
Exploration & Exploitation for innovation	19	7	24	31
Structural perspective	89	16	126	142
Organisational Relationships	25	5	35	40
Governance-leadership-Institutions	60	12	85	97
Temporal perspective	65	11	93	104
Contextual perspective	75	11	110	121
Capabilities	47	9	67	76
Knowledge-Information-Learning	68	12	98	110
Managerial roles	70	15	98	113
Management Mechanisms	16	4	22	26
Performance	67	11	97	108
Multi-dimensional approach	5	0	9	9
ICTs	16	2	24	26
Value addition	6	0	10	10
Entrepreneurship	3	0	5	5

2.4.3.1 Exploration and exploitation for innovation

Ambidexterity concerns the management of exploration and exploitation. There are three perspectives in the literature to manage exploration and exploitation—structural, temporal and contextual, which some authors present as solutions to foster organisational ambidexterity (O'Reilly and Tushman, 2008, Nosella et al., 2012). Considering that in innovation processes the management of exploration and exploitation refer to dynamics that involve multiple stakeholders

in multi-level innovation networks, we present the three perspectives as *managerial challenges* given their complexity:

(1) In total 89 percent of the studies (Table 2.4) include references to managing *structural challenges* of exploration and exploitation in an innovation process. The debate pivots on whether exploration and exploitation positively or negatively influence innovation performance, managed in differing organisational structures.

Two dimensions for managing exploration and exploitation in organisations have been proposed (Cao et al., 2009a): (i) A Balanced Dimension - through separated organisational structures to carry out different tasks independently, or (ii) A Combined Dimension –through integrated structures which combine work units to carry out different tasks together. The balanced dimension refers to the “match in the relative magnitude of explorative and exploitative activities” and the combined dimension seeks to “increase the combined magnitude of both explorative and exploitative activities” (Cao et al., 2009a page 782). The choice of the dimension for managing structural challenges of exploration and exploitation, changes according to the context. A combined dimension has resulted in better performance for large firms. These large firms generally have good access to internal and external resources and formal management expertise, which improves their capability to react to challenges (Chang and Hughes, 2012). In contrast, in SMEs, where there is limited formal managerial expertise, a balanced approach to exploration and exploitation through management by different business units has resulted in good outcomes (Chang and Hughes, 2012).

In more complex structures, like innovation networks, the structural challenges of ambidexterity are managed by inter-organisational relationships (Kauppila, 2010). One quarter of the studies

(Table 2.4) looked at the management of inter and intra organisational relationships (ORs) for exploration and exploitation. There were 37 codes in the organisational theme, extracted from studies of supply network innovations (Narasimhan and Narayanan, 2013), networks of practice (Agterberg et al., 2010), ambidextrous clusters (Ferrary, 2011), multi-stakeholder settings (Minoja, 2012, Moellenkamp et al., 2010), international new ventures (Han and Celly, 2008), ‘dual networks’ (Capaldo, 2007), and hybrid structures of innovation networks (Schemeil, 2013). These studies provide empirical evidence of the emergence in the literature of ambidexterity as a capability of networks, and the importance of the management of inter-organisational relationships for exploration and exploitation.

Alliances are a particular form of inter-organisational relationship with their own form of ‘alliance ambidexterity’ (Tiwana, 2008), with strong ties to integrate diverse knowledge, and bridging ties to create new knowledge from diverse expertise. The conscious management of the different properties of the alliances (size, heterogeneity, synergies, constraints, etc.) via ‘Alliance Portfolios’ (Faems et al., 2012), is important and has an influence on the performance of innovation networks. Vanhaverbeke et al. (2012) combine governance and competence views of technology-based collaboration, looking at relational and structural embeddedness, and the role of (non) redundancy affecting the creation of new technology. They find that “collaboration with direct ties is only useful up to a point as the addition of too many partners will carry unfavourable consequences for the creation of both core and noncore technology” (Vanhaverbeke et al., 2012 page 799).

(2) *Temporal challenges* are mentioned in 65 percent of papers, and refer to the need to manage the timing of an innovation process, where exploration and exploitation are stages in the cycle of innovation. Different emphasis is placed on stability and flux depending on the stage in the

innovation cycle and the societal challenges being faced. Lee et al. (2013) suggest that the temporal cycling between the long time horizon of exploitation and the short time horizon for exploration are an alternative balancing mechanism of exploratory and exploitative innovation. Exploration is a stage of looking for new ways of doing things (differentiation), and exploitation is a stage of implementation and consolidation of the capabilities (Nooteboom, 2000), as cyclical stages in *continuity*. Other scholars see exploration and exploitation from the view of *orthogonality*, where exploration and exploitation take place at the same time, but often by different functions and organisations (Gupta et al., 2006). When managing exploration or exploitation stages of innovation, the timing (as a continuity or as orthogonal processes) is likely to have an effect on performance and outcomes of the innovation process. For instance, Kuckertz et al. (2010 pg. 179) state “the longer it takes for a company to launch new innovation activities, the lower its innovation performance will be”.

(3) The third perspective, *contextual challenges*, refers to ambidexterity as a capability to manage challenges presented in the “environment” of an innovation process. This theme was mentioned in 75 percent of papers (Table 2.4) and it emerges *per se* as a complex construct given the multi-dimensional boundaries (geographical, institutional, political, etc.) of the environment in which exploration and exploitation are embedded. In the context of firms, Bedford (2015) proposes the use of management control systems across different modes of innovation in different contexts, by using a combination of different levers of exploration and exploitation (diagnostic, interactive, boundary and belief control systems) to have an effect on firm performance.

An emerging theme on ambidexterity is the virtual space of the internet where the dynamics of innovation of multiple organisations are mediated by the use of information and communication

technologies (ICTs) (Ashurst et al., 2012). There are also institutional elements—such as rules, reward systems, and power division—which are mentioned in studies on adaptable international organisations (Schemeil, 2013), adaptive management of multiple stakeholders (Minoja, 2012), and studies of inter-organisational networks of practice (Agterberg et al., 2010), which need to be considered when managing exploration and exploitation. In the case of international organisations, Schemeil (2013) stresses that these organisations should couple technical and political aspects using dual decision-making to have a balance between performance and resilience in collaborative efforts.

2.4.3.2 Ambidexterity as a higher order dynamic capability for innovation

Ambidexterity is a higher order capability that involves multiple and ‘hybrid capabilities’ (Menguc and Auh, 2008) to manage exploration and exploitation dynamics (Gibson and Birkinshaw, 2004, Carmeli and Halevi, 2009, Hotho and Champion, 2010). Consequently, managing the structural, temporal and contextual challenges entails a combination of capabilities, as found in 47 percent of studies (Table 2.4, 30 codes and 73 quotations).

Ambidexterity demands different types of learning to develop capabilities required for innovation. Some authors make the distinction between monodextrous capability (to pursue either exploration or exploitation) and ambidextrous capability (capability to pursue simultaneously exploration and exploitation). In behavioural and cognitive studies ambidexterity is related to exploratory and exploitative ways of learning (Kostopoulos and Bozionelos, 2011), integrating knowledge from different sources to foster learning capabilities (Beckman, 2006, Lin et al., 2013, Fang et al., 2012). Examples of learning capabilities related to ambidexterity are absorptive capacity (Hoang and Rothaermel, 2010, Andriopoulos and Lewis, 2009), perspective taking (Litchfield and Gentry, 2010), and ambidextrous learning (Kang and Snell, 2009, Lee and Huang, 2012).

Chang et al. (2012) present a typology of capabilities like integration, openness, autonomy and experimentation. They found that experimentation is the most significant capability for radical innovation of firms, followed by integration capability (to have more access to diversified sources for innovation) or openness (access to external sources of knowledge). Alignment and adaptability are other capabilities mentioned by Weigelt and Sarkar (2012) in their study of outsourcing for the adoption of internet services in US banks. They emphasise the importance of managing the organisation of activities in different business units or in dual structures (alignment capability), but also the need of adaptability as a capability for solving problems. Similarly, Thongpapanl et al. (2012) refer to the simultaneous pursuit of alignment and adaptability in the context of Canadian firms, emphasising the need of considering the boundary conditions, and using different structural ways to manage firms according to the context. They conclude that the relationship between alignment and adaptability is better fostered when there is shared responsibility.

In their capability based framework on ambidexterity, Lichtenthaler and Lichtenthaler (2009) integrate six knowledge capabilities (inventive, absorptive, transformative, connective, innovative, and desorptive) for managing internal and external knowledge bases for achieving ambidexterity and superior innovation performance. However, studies into the combination of internal and external knowledge have been usually applied to exploration and exploitation inside the firm (Lichtenthaler and Lichtenthaler, 2009). Combining internal and external knowledge for achieving ambidexterity in the context of networks in open innovation processes is an area that requires further research.

Schemeil (2013) adds an institutional view on capabilities, mentioning the need of hybrid international organisations (that combine public and private organisations) to balance resilience and performance (exploration and exploitation) through ambidextrous and adaptive capabilities, combining the technical with the political in a dualistic approach.

The empirical evidence shows that capabilities related to ambidexterity are multiple and even hybrid. ‘Embeddedness’, for instance, is a cross-cutting capability related to structural as well as contextual challenges. Agterberg et al. (2010) proposed four types of embeddedness for managing intra-organisational networks of practice: ‘structural’, ‘relational’, ‘organisational’ and ‘embeddedness in practice’. Ferrary (2011) emphasised the importance of the embeddedness of specialised organisations within regional clusters that include a variety of exploration-oriented organisations (e.g. universities, R&D centres, SMEs and start-ups).

Mobility is another capability to manage contextual challenges. Mobile communities of practice using ICTs are a social mechanism to balance contextual challenges by mobilising communities of work (Kietzmann et al., 2013). Mobility is also a capability mentioned in the literature of networks of practice (NOP) underlined in the expression of “wheels in motion”.

Entrepreneurship is an important capability related to ambidexterity and innovation performance mentioned in three percent of the studies (Table 2.4), to translate exploration and exploitation results into economic performance.

2.4.3.3 Managerial roles in innovation processes

Managerial roles were mentioned in 70 percent of the articles reviewed (Table 2.4).

Ambidexterity has usually been seen as a capability fostered by the roles of managers. However,

we found a diversity of civil society actors playing managerial roles at micro, middle and macro level.

Regarding temporal, structural and contextual challenges, the majority of roles that we encountered in the literature were related to tackling structural challenges or to fostering knowledge and learning capabilities, with relatively few roles identified for tackling temporal challenges.

General roles are focused on knowledge management, which includes information and learning mechanisms: routinisation of knowledge (Parmigiani and Howard-Grenville, 2011); co-design of participatory processes, boundary spanning, brokering external knowledge and scenario planning process (Bodwell and Chermack, 2010). At the level of networks, we identified roles like building peer networks (Lyytinen et al., 2010), managing networks of practice (Agterberg et al., 2010), facilitating inter-organisational and social learning, and facilitating the combination of direct and indirect ties and alliances for fostering knowledge exchange (Xu et al., 2013, Ambos et al., 2008). Agterberg et al. (2010) suggest that the management of interventions should be dynamic and embedded through the connections (structure and quality of ties) and content (knowledge being shared and created) in networks. Roles depend on the organisational design (Tushman et al., 2010), whether it is for supporting exploration and/or exploitation, with possible transitions over the innovation process. Chanda and Ray (2015) mention the importance of the environment in determining a focus on exploration or exploitation, they call this ‘managerial intentionality’, and emphasise that the management of exploration and exploitation is not always an act of balancing exploration and exploitation. In line with these ideas, Tushman et al. (2010) found that ambidextrous organisation designs in product-oriented firms were more effective than functional, cross functional and spinout designs for simultaneous exploration and exploitation

(particularly under crisis conditions), with a combination of roles, structures and senior team processes, fostering multiple learning contexts.

Rosing et al. (2011) explain how different leadership roles (sponsors, mentors, critics and institutional leaders), and the ability to change and play more than one role, influence the innovation process. Yang et al. (2014) emphasise the important roles of managers of fostering a collectivistic culture in order to balance exploration and exploitation. A collectivistic culture might be an interface to manage different individual interests, time and resources. In line with this collective perspective, Turner et al. (2013) summarise roles in three groups of management mechanisms for ambidexterity: (1) the role of organisational capital for managing social structures, (2) the role of social capital for managing organisational relationships, and (3) the role of human capital that considers leadership as a key factor for ambidexterity.

2.4.3.4 Measuring performance: from economic to more holistic approaches

The ‘measuring performance’ theme has 29 codes and 291 quotes, with 67 percent of papers measuring or mentioning performance (Table 2.4).

Ambidexterity influences the innovation performance and outcomes of organisations (de Visser et al., 2010b, Leidner et al., 2011), particularly for firms for which the assessment of performance is based on profit and economic impacts.

However, there is a small shift toward new approaches to measure ambidexterity and its outcomes going further than purely economic variables. Value addition, both to product and also process through social innovation, was mentioned in 16 percent of studies. The management of organisational relationships (ORs) to foster the vertical and horizontal integration of networks (Capaldo, 2007, Agterberg et al., 2010, Tiwana, 2010, Vanhaverbeke et al., 2012) was identified

as a source of value addition to processes. The high interest in the management of ORs (89 percent of studies) is precisely a major area of interest to scholars due to its importance for the performance and outcomes. For instance, Blome et al. (2013) present their concept of ambidextrous governance in the context of supply chains, looking at the governance capacity of firms to pursue simultaneously relational and contractual governance, which positively influences both 'cost' and 'innovation' performance. Carayannis et al. (2015) emphasise the need of organisational design and governance to address problems of power distribution, control, and hierarchy, and propose the concept of *quintuple helix* that governs ecology, knowledge and innovation to create a synergy between economy, society and democracy. Carayannis et al. (2015) also underline the need of creating different business models that go further than economic profit to provide solutions to societal and environmental challenges in a sustainable manner. Likewise, Minoja (2012) introduces the concept of Corporate Social Responsibility, which extends the assessment of performance from economic outcomes of organisations to ethical issues. In the case of international organisations, Schemeil (2013) proposes that their relative success can be measured as a global balance among performance and resilience, exploitation and exploration, autonomy and cooperation.

Other scholars assessing performance focus on system capabilities such as knowledge management, collaboration, project management, ambidexterity, information technology–innovation governance, business information system linkage and process modelling. Tarafdar and Gordon (2007) combine the *resource based view* looking at technical (hardware and software), human and intangible resources, and a *competency resource view* of information systems for process innovation. The capability-based framework focuses on combinative and competitive capabilities, and the effect of ambidexterity on business performance (Durisin and Todorova, 2012). Ho et al. (2011) not only study the effect of ambidexterity on business

performance but also refer to ambidexterity as a capability to manage technological and design capabilities.

2.5 Stage D: Gaps and further research

In this section we address our third research question:

III. What are the gaps found in the literature of ambidexterity?

One hundred and twelve documents reported at least one gap (131 codes) (Table 2.5). Most suggestions on gaps were made 2012, coinciding with a peak on the number of publications on ambidexterity.

Table 2.5. Percentage of papers covering gaps and number of papers covering each gap per year

Gaps	% of papers covering gap	Total
Structural	46	51
Governance, leadership and inter-organisational relationships	34	38
Temporal	45	50
Contextual	45	50
Capabilities	14	16
Learning and Knowledge	29	33
Managerial roles	42	47
Performance	72	81
Multi-dimensional approach	8	9
ICTs	3	3
Empirical studies from other countries	13	14
Other suggested areas of research	19	21

2.5.1 Gaps on Structural, Temporal and Contextual Challenges

46 percent of the papers mentioned gaps on structural challenges (Table 2.5). In particular, Gupta et al. (2006) suggest examining the challenges for achieving a balance between exploration and exploitation, how exploration and exploitation interact at different levels, and how this process is managed across levels of analysis. The management of exploration and exploitation structural challenges is also a gap mentioned explicitly in 34 percent of the studies (Table 2.5) with Turner

et al. (2013 pg. 328) suggesting to “develop a generalizable theory on how ambidexterity can be a deliberate strategy within a complex organisational structure”.

Innovation networks are new ways of knowledge production for the exploration of synergies and the exploitation of complementarities (Pyka and Küppers, 2002), whose structural challenges relate to the access and management of resources, especially knowledge. These challenges have a great influence on learning and the development of capabilities in innovation networks. In the open innovation paradigm the management of structural challenges in innovation networks is even more important given the external and internal flow of resources, but this topic has not received sufficient attention. Faems et al. (2012) note that, while alliance scholars have contributed insights on the structural dynamics of networks, there is still a gap in our knowledge on how “firms actually manage those networks” (Faems et al., 2012 pg. 262).

Gaps associated with managing temporal challenges were mentioned in 45 percent of the papers (Table 2.5). An overarching gap to be addressed is how organisations simultaneously attain exploration and exploitation (Simsek, 2009). In multi-level innovation networks, a key unanswered question is how the timing of exploration and exploitation is managed, and how those innovation networks evolve over time. Although timing of exploration and exploitation was mentioned in various studies, few actually look at stages of exploration and exploitation of an innovation process and the effect of timing on the performance of organisations. From the sample only seven empirical studies use a longitudinal approach to investigate how the timing of exploration and exploitation is managed. Various scholars have suggested conducting longitudinal studies to explain the dynamic aspects of ambidexterity (O'Reilly and Tushman, 2008, Cantarello et al., 2012), and how it evolves over time (Turner et al., 2013, Chang et al., 2011). Alpkam et al. (2012) more explicitly recommend a period of ten years or more to collect

longitudinal data. Other scholars have suggested not just longitudinal studies but also observations from different cultural contexts (Lin et al., 2013). Schemeil (2013) suggests longitudinal research to compare international organisations (IOs) with other adaptive hybrids that span a diversity of organisations (universities, NGOs, etc.). Longitudinal research on timing would allow the investigation of whether exploration and exploitation should be managed orthogonally or as a continuity (Gupta et al., 2006), and as a dynamic capability (O'Reilly and Tushman, 2008).

Contextual challenges were mentioned as gaps in 45 percent of the papers (Table 2.5). In open innovation, the alignment of internal and external knowledge for achieving ambidexterity is an area for further research (Lichtenthaler and Lichtenthaler, 2009). Empirical evidence indicates that in open innovation processes in which multi-level and ever more international networks participate, there are multiple boundaries that might enable or limit the collaborative efforts for exploration and exploitation of those networks to achieve ambidexterity (e.g. geographical, institutional, cultural and so forth).

2.5.2 Gaps on the study of managerial roles to foster ambidexterity

Gaps in knowledge on managerial roles for fostering ambidexterity were mentioned in 42 percent of the papers (Table 2.5). We found that the roles are not limited to those of formal managers but also include those of other civil society actors from different productive sectors. An area for further research is how these roles maintain dynamism in the management of exploration and exploitation.

A specific gap in the literature is how the collective roles of stakeholders can manage transitions of organisational designs (Tushman et al., 2010) for supporting exploration and exploitation at different network levels and at different stages of the innovation process. Oborn et al. (2013) suggest further investigation on the effectiveness of different brokering roles, and the

implications of different forms of governance. de Visser et al. (2010a) recommend studying how structural design choices combined with the presence of specific roles affect different kinds of innovation outcomes.

2.5.3 Gaps on the study of performance, governance and capabilities in innovation processes

72 percent of papers reported gaps on performance (Table 2.5), which concerns not just product innovation, but also process innovation. Therefore, the performance in innovation processes should be assessed in a holistic way, assessing outcomes not limited to economic indicators but in combination with social dimensions of value addition and fostering of capabilities (Nosella et al., 2012, Durisin and Todorova, 2012). According to Nosella et al. (2012 pg. 460) “the fine grained, multi-layered nature of routines and capabilities has been almost entirely ignored”.

Eight percent of papers reported on the gap of a multi-dimensional approach (Table 2.5), which is not only a theoretical but also a developmental gap.

Some authors suggest further research on the influence of governance on performance (Blome et al., 2013), or the influence of governance on knowledge translation (Oborn et al., 2013). Mueller et al. (2013 pg. 1631) also suggest viewing “networking as a mode of balancing within a network of organisations” and recommend observing how different institutional settings in which partners of the networks are located influence the outcomes of this balancing mode. Some specific areas of application are suggested. Three percent of papers requested further research of virtually mediated ambidexterity in the context of ICT enabled innovations. Koenig et al. (2013) suggest further research on the influence of family on firm innovation, and its effect on complex forms of organisational ambidexterity. Few empirical studies have been conducted in developing countries, and this was an area of further research suggested by 12 percent of the papers, with Lin et al. (2013) requesting more studies from emergent economies.

Given that ambidexterity has been defined as a higher order and dynamic capability, there is a need to examine how different ways of orchestration of innovation networks through different network governance mechanisms influence the fostering (or hindering) of the capabilities of the innovation network.

2.6 Summary with more recent emerging themes and research agenda

To bring our review completely up to date we assessed journal review papers from the period 2014 to 2017, using the same search terms and databases. Most research themes and identified gaps in research are in line with our systematic review until 2014. We discovered two new themes but little intensification of research into innovation networks with recent reviews maintaining a focus on organisational ambidexterity with organisations as the prime unit of analysis.

A new theme in relation to ambidexterity is complexity theory. Poutanen et al. (2016) propose complexity theory for innovation research, approaching innovation as a non-linear process. However, what embracing ambidexterity implies for managing conditions like boundaries, interconnectedness, self-organisation of the system parts and adaptiveness are questions that require further research.

Another emergent theme in the literature is on ambidextrous cognitive frames. Lin and McDonough (2014) emphasise the importance of ambidextrous cognitive frames for fostering innovation ambidexterity in the context of 178 Taiwanese companies (190 strategic business unit or SBUs) operating in chemicals, pharmaceuticals, financial management, mechanical engineering, and electronic engineering sectors. They found that an ambidextrous cognitive frame combines an independent cognitive style, which was found to have a positive impact on

intra-learning in the (SBU) level; and a reflection cognitive style, which was found to have a positive impact on inter-SBU learning. The authors suggest conducting studies on ambidexterity in an international context using a cross-national research to see differences in individual orientation and their impact on innovation ambidexterity.

Table 2.6 gives a summary of main findings of the complete review, including the major and emergent research themes and gaps identified in empirical research on ambidexterity.

Table 2.6. Summary of findings

Sectors and settings	Unit of analysis studies	Main themes	Emergent themes	Gaps and further research
Mainly in large firms	Individual, teams, organisations, networks	Structural, contextual and temporal managerial challenges	Ambidexterity as a capability of networks.	More studies on various industries, and emerging economies.
Mainly developed countries			Ambidexterity related to hybrid, multiple capabilities.	Longitudinal studies to track ambidexterity as a dynamic capability
			Need of multi-dimensional approach.	
			ICT mediated ambidexterity.	Multiple levels and across different cultural, institutional and international context
			Ambidexterity and Complexity Theory	
			Cognitive ambidextrous frames	Need of a holistic approach-capability view
				Measuring performance of networks on capabilities in innovation processes.

We find that ambidexterity is a capability that has highly captured the interest of scholars, particularly the management of structural challenges, which have a particular influence on the performance and outcomes of organisations. However, we found that the relationship between ambidexterity and the performance of networks had received little attention. Therefore, ambidexterity in the context of networks is an important emergent area for further research. Some authors have emphasised the need of a more holistic approach when measuring performance and outcomes. Considering that ambidexterity as a higher order capability that involves ‘hybrid capabilities’ (Menguc and Auh, 2008), and that it is a dynamic capability (Cantarello et al., 2012), a capability view is envisaged as key. A capability view would consider how ambidexterity relates to other capabilities and how influences the performance and outcomes of organisations and networks in innovation processes.

Concluding, overall, we see a development towards research including multiple actors with multiple capabilities in multiple settings, reflecting the increasing interests in open innovation processes. The design, coordination and management of innovation processes (Martini et al., 2013, Mueller et al., 2013), and the roles that different stakeholders play for orchestrating exploration and exploitation of innovation networks, are very relevant for further research. A key question is how the management design and network governance mechanism used for the exchange of resources (not only knowledge) can enhance the performance and outcomes. For instance, in relation to ambidextrous cognitive frames Lin and McDonough (2014), it is inferred that certain management designs and network governance mechanisms might enable processes of intra and inter-learning for managing the cognitive gaps and contradictions of exploration and exploitation, particularly when a diversity of stakeholders at multiple networks levels participate in an innovation process.

Regarding research methods, there are suggestions to conduct cross-sectional studies on ambidexterity of various industries, and also in emerging economies, looking at multiple levels and across different cultural and institutional contexts (Raisch et al., 2009, Wang and Rafiq, 2014, Chang, 2015). Longitudinal approaches have been also suggested to see how ambidexterity takes place in practice (Turner et al., 2013) and as a dynamic capability (Cantarello et al., 2012).

This review contributes towards identifying gaps for developing a theory of ambidexterity as a managerial strategy for orchestrating multi-level innovation networks that tackle challenges in innovation processes. We have seen that ambidexterity is a dynamic capability that entails other capabilities, which are likely to be crucial for the performance and outcomes of innovation processes. Likewise, indicators of network capabilities are necessary to track and assess the effectiveness of networks to tackle structural, contextual and temporal managerial challenges in innovation processes. We therefore suggest further research to assess the effectiveness of certain management designs and the orchestration of innovation networks to foster network capabilities.

Tackling complex global problems such as food insecurity, climate change, and poverty often requires the coordination of sometimes widely dispersed stakeholders that join multi-level innovation networks. These networks need to adjust their activities to different contexts, and must coordinate very different agendas and timing of their constituent organisations. All these dynamics require management to produce better outcomes in innovation processes.

Ambidexterity is then a key capability to manage such complexity in innovation processes, identifying those structural, contextual and temporal challenges that need management for more effective outcomes.

Chapter 3. Stakeholder roles for fostering ambidexterity in Sub-Saharan African agricultural netchains⁴

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3.1 Introduction

In Africa an estimated 80% of farms are below two hectares (Wiggins, 2009) and producers are hindered by a scarcity of financial resources, degradation of natural resources, an uncertain climate, and a rapidly changing landscape of markets and consumer demands. Many agricultural producers also experience information and power asymmetries that exclude them from benefiting from opportunities offered by local, national and international markets. Smallholder farmers can tackle these challenges by forming networks to benefit collectively from shared information, knowledge, improved capacities and economies of scale in a process of innovation. Such ‘innovation networks’ have always existed but have only recently been theorised as a ‘new form of organisation within knowledge production for the exploration of synergies and the exploitation of complementarities’ (Pyka and Küppers, 2002) in an innovation process. Farmers may be part of larger innovation networks, but also be part of self-help approaches, such as producer organisations, which are a collective mechanism for farmers to pool resources to benefit from economies of scale and overcome challenges such as lack of technologies or credit, limited access to markets, and poor infrastructure for processing (Ton, 2008, Arnould et al., 2007, Mendoza and Thelen, 2008). Cooperatives are a specialised type of producer organisation that ‘...is an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly owned and democratically controlled enterprise’ (International Co-operative Alliance, 2015). Ton et al. (2007) argue, however, that most benefits offered by farmer cooperatives in developing countries reach relatively resource-rich farmers, offering less to the majority of potential beneficiaries.

Over the past 20 years there have been various agricultural research and development (R&D) intervention approaches that aim to improve the flow and production of knowledge and technologies to improve the livelihoods of smallholder farmers in Sub-Saharan developing countries. Agricultural R&D interventions for the diffusion of technological packages have been criticised (Staatz and Dembélé, 2008) because they mainly focus on exploration, i.e. knowledge

sharing and learning activities, rather than exploitation, which transforms learning into tangible economic outcomes via, for instance, contract farming or business networks.

Consequently multi-stakeholder platforms have been proposed to enhance the capabilities of producer organisations to explore solutions to production challenges, exploit market opportunities and benefit economically (Devaux et al., 2007, Kaaria et al., 2008, KIT et al., 2006, Lightfoot and Scheuermeier, 2007, Prasad and Hambly, 2009, Sanginga et al., 2004, Shepherd, 2007). Multi-stakeholder platforms are a complex innovation network established to help farmers address multi-dimensional problems, by allowing for interaction among stakeholders at various levels of an agricultural value chain. This combination of value-chain and innovation network results in a type of netchain, i.e. “a set of networks comprised of horizontal ties between firms within a particular industry or group, such that these networks (or layers) are sequentially arranged based on the vertical ties between firms in different layers” (Lazzarini et al., 2001 pg 7).

3.1.1 *Ambidexterity in netchains*

Ambidexterity is a concept used in management and innovation studies to describe the ability of organisations to manage simultaneously exploration and exploitation (O'Reilly and Tushman, 2008), and is comparable to the human physical capability to conduct an activity easily with both hands (Moreno Luzon and Valls Pasola, 2011). Ambidexterity as a managerial capability was traditionally studied in mainly large firms from developed countries, and subsequently in R&D organisations in the context of inter-firm collaboration (Michelfelder and Kratzer, 2013, McCarthy and Gordon, 2011, Riccaboni and Moliterni, 2009). Gilley et al. (2010) observe ambidexterity at the team level, which could be the case of smallholder farmers who explore new ways of doing things (exploration) for tackling their problems in communities of practice formed with family peers and neighbours. Other studies show ambidexterity as a capability of larger innovation networks (Turner et al., 2013), which is the case of smallholder farmers participating in agricultural R&D interventions.

Currently the open innovation paradigm (Chesbrough, 2003) implies the blurring of hybrid organisation boundaries in innovation networks, and the inclusion of various stakeholders facilitating innovation processes to solve collective problems. In this paradigm the concept of ambidexterity has further evolved into a more collective managerial capability, pursued by diverse actors of civil society and various productive sectors, such as small and medium enterprises (Chang et al., 2011), supply chain networks (Narasimhan and Narayanan, 2013), projects (Li and Huang, 2013), entrepreneurial universities (Ambos et al., 2008, Chang et al., 2009, Tahar et al., 2011), family (Koenig et al., 2013), and individual-leadership levels (Rosing et al., 2011). In netchains, there is an aggregative and complex setting of networks with multiple actors at multiple levels. Managing the netchain for exploration and exploitation is far from easy due to the diversity of hybrid organisations and the complexity of the challenges. It is therefore important to understand how the roles of managers and other stakeholders at different network levels foster ambidexterity as a collective managerial capability in netchains.

3.1.2 Stakeholder roles for fostering ambidexterity in netchains

Simultaneous exploration and exploitation requires netchain stakeholders to play roles to manage contradictory strategies like flexibility versus efficiency, open versus closed innovation, incremental versus radical innovation, and formal versus informal control (Cantarello et al., 2012). The tensions resulting from these contradictory strategies represent three inter-related types of challenges: temporal, structural and contextual.

Temporal challenges relate to the timing of managing netchains for change, simultaneously exploring new approaches and exploiting new capabilities. This management maintains the ‘cycle of innovation’ (Gilsing and Nooteboom, 2006), which might be repeated various times at different organisational levels if resources are available (Van de Ven et al., 2008). Few studies report on specific roles played in the timing of innovation processes, or observe the dynamics of exploration and exploitation over time. O'Reilly and Tushman (2008) mention the importance of dynamic capabilities, like sensing, seizing and reconfiguring, for managing timing in large firms

in developed countries. In the automobile industry, Adler et al. (2009), show how Toyota managed exploration and exploitation by its continuous learning approach, introducing deliberate perturbation to avoid routinisation and stagnation. Managing temporal dynamics in some telecommunication firms (Ferrary, 2011) has been achieved by engaging in a cycle of disruptive innovation where ambidexterity is a capability of a cluster of organisations (e.g. universities, research laboratories, law firms, and investment banks), who individually specialise in exploration, exploitation or the transition between the two. In this case of disruptive technology-driven open innovation the timing is managed via market or quasi-market mechanisms (Ferrary, 2011). There is, however, a dearth of studies on which roles are important for managing temporal challenges in agricultural netchains in developing countries where the pace of the innovation process might be slower than in developed countries and where there is less emphasis on new technologies and more on optimising social processes for solving problems in more complex unstable environments.

Structural challenges relate to the configuration of actors in a social structure to organise exploration and exploitation in an innovation process. Managing structural challenges in netchains refers to how different roles can help to organise collective action of stakeholders, whether by working separately in innovation networks with peers, or in combination with other stakeholders at different levels of the innovation network. Network management and coordination are suggested as important roles to foster ambidexterity of networks, managing the network diversity, network governance (Vanhaverbeke et al., 2012), and network mobility (Dhanaraj and Parkhe, 2006). Enhancing the connectedness of societal actors, through facilitating both loose organisational relationships (ORs) for exploration, and more formal alliances for exploitation (Gilsing and Nooteboom, 2006), is also important (Capaldo, 2007, Tiwana, 2008, Tiwana, 2010, Vanhaverbeke et al., 2012). Facilitating ORs also adds value in an innovation process since it affects the integration, alignment, and openness of the innovation

network and hence the ability to organise collective action, share resources and foster other capabilities.

Roles like boundary spanning, facilitating the combination of direct and indirect ties for knowledge exchange (Tiwana, 2008, Vanhaverbeke et al., 2012), facilitating competitor alliance relationships, facilitating organisational and social learning; brokering external knowledge, building peer networks (Lyytinen et al., 2010), co-design of participatory processes, are important for overcoming structural challenges. Strategies like managing networks of practice (Agterberg et al., 2010) and management of information and communication technologies (ICT's) are also important. However, most studies have been conducted in organisations in developed countries, and there are few insights from developing countries on the roles for managing structural challenges, particularly in complex social structures like netchains (Martini et al., 2013, Mueller et al., 2013, Turner et al., 2013).

Contextual challenges in the innovation process refer to how exploration and exploitation in innovation networks are managed within spatial, institutional, political, and technological boundaries (Mueller et al., 2013, Schemeil, 2013). When comparing differences between Japanese and Korean firms, for instance, Yoon and Chae (2012) show how decision making structures (decentralisation and control) depend on the nature of the external environment, and that market, clan and bureaucracy influence the management designs to manage paradoxes (different management styles of exploration and exploitation). More fundamentally, Mueller et al. (2013) show how institutional factors, like national culture (e.g. different conception on power distance) have an impact on the benefits to firms of exploratory innovations, whereas those same factors had less effect on the benefits derived from exploitative innovations.

Institutional boundaries can be determined by modes of governance (Blome et al., 2013), formal and informal control (Tiwana, 2010), and systems of rewards and sanctions. Other innovation boundaries are virtual- mediated by ICTs (Ashurst et al., 2012).

Managing contextual challenges requires adaptability (Weigelt and Sarkar, 2012, Thongpapanl et al., 2012), adaptive management (Moellenkamp et al., 2010), environmental dynamism and embeddedness, as well as access to organisational capital, human capital (Zhou et al., 2013), social capital and the more political and institutional roles of global institutions (Schemeil, 2013). However, it is less clear who plays which roles to span and mobilise multi-dimensional contextual boundaries (Gupta et al., 2006, Nosella et al., 2012). Similarly the role that information and communication technologies can play (Martini et al., 2013) to foster ambidexterity in netchains is a gap in the literature.

Hence the research question that we address in this paper is the following:

What roles are played and by whom to foster ambidexterity in netchains for tackling challenges faced by smallholder farmers in Sub-Saharan African countries?

The next section will present our multi-case longitudinal research design and describe briefly our choice of cases and analytical approach. This is followed by the results of our analysis specifically focusing on the challenges encountered and the roles played to tackle those challenges. Finally, we conclude and discuss the implications of our findings on the roles played by traditional managers and other civil society stakeholders in innovation processes, with propositions for management design.

3.2 Methods and Materials

3.2.1 Sub-Saharan African potato netchain case studies

We used a multi-case longitudinal design to observe the management of temporal, structural and contextual challenges in six netchains, selecting a single agricultural enterprise – potato production and marketing.

We selected the case study method since it is appropriate for addressing research in which the researcher has little or no control of events (Yin, 2003). Our case studies comprised six farmer

Stakeholder roles for fostering ambidexterity in Sub-Saharan African agricultural netchains groups (Figure 3.1) as part of different levels of innovation networks collectively tackling challenges of potato (*solanum tuberosum*) netchains in south west Uganda, northwest Rwanda and eastern Democratic Republic of the Congo (DR Congo).

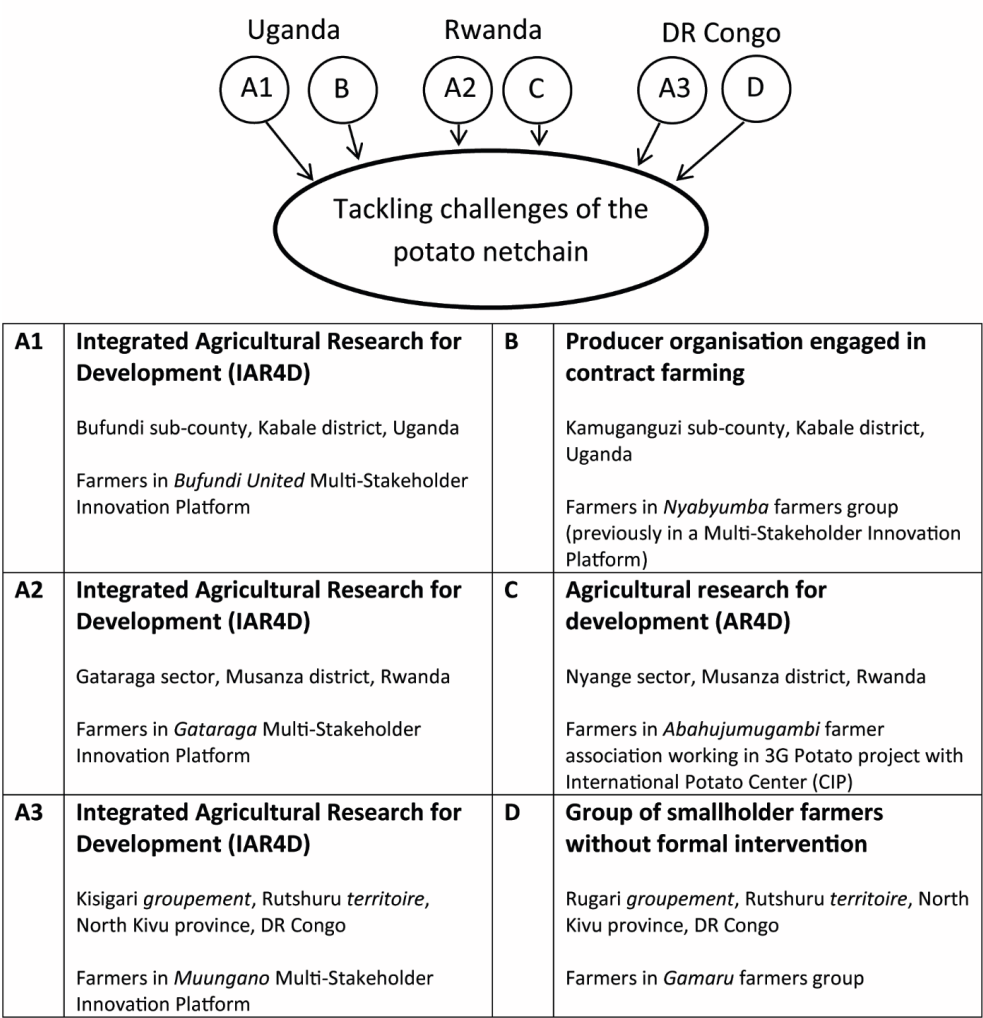


Figure 3.1. Case Studies

Three cases were smallholder farmer groups, taking part in multi-level innovation networks, that were supported by multi-stakeholder innovation platforms (MSIPs) (Figure 3.1, A1, A2, A3).

These farmer groups were participating in the Lake Kivu Pilot Learning Site of the Sub-Saharan Africa Challenge Program (SSACP) implementing the Integrated Agricultural Research for Development (IAR4D) approach. The SSACP was conceived to implement and prove the effectiveness of IAR4D (Hawkins et al., 2009), addressing interactions between agricultural productivity, natural resource management and linkages to markets (Buruchara et al., 2013). Key principles of IAR4D at the time of implementation (FARA, 2007) were: (i) Multi-sectorial, multi-institution coalition of actors; (ii) non-linear collaboration among actors, in contrast to conventional agricultural R&D that is focused on technology transfer; (iii) address constraints along the whole value chain; (iv) multidisciplinary and participatory research process, and; (v) incorporate capacity building for all actors.

The fourth case was a farmer group that participated as part of a large innovation network engaged in contract farming, with a history of involvement in a MSIP (Figure 3.1, B). The fifth case was a large innovation network in which farmers participated in a conventional agricultural R&D intervention (Figure 3.1, C), with the diffusion of technology by the International Potato Center (CIP). Finally, the sixth case (Figure 3.1, D) is a farmer group being part of a small innovation network, without any formal intervention. Cases B, C and D were chosen for their similarities in context and were considered in the SSACP as counter-factual sites to cases A1, A2, and A3 respectively (Farrow et al., 2013).

3.2.2 Tracking the roles of stakeholders tackling challenges in the innovation process

The cases represent different configurations of innovation networks, involving certain layers of the netchain. We compare the roles played in the MSIPs with the other cases with the assumption that a MSIP has more layers of the netchain and stakeholders involved in the process. Turner et al. (2013) suggest using qualitative approaches to study what roles are played and by whom to manage exploration and exploitation in complex settings, particularly for studies from emerging economies (Wei et al., 2011).

The data collection comprised two phases, with the objective of capturing the roles of stakeholders at different phases of the innovation process. We identified challenges and described the innovation trajectories of each case to draw similarities and differences on roles in the innovation process of these networks. We complemented the primary data with project reports, institutional brochures, minutes of meetings, didactic manuals and innovation platform action plans. There was also frequent communication with stakeholders after the primary data collection phases.

3.2.2.1 First phase of data collection

In the first phase of data collection in October 2010, we conducted key informant semi-structured interviews. We asked farmers what were the main challenges that they faced in the potato netchain in their district or province. The questions were retrospective, and covered antecedents (since one of the cases had the antecedents of participation in a multi-stakeholder platform) of the innovation process of the farmer group, and the arrangements that were made by the innovation networks until the point of time of this interview. We asked farmers which stakeholders had been playing which roles to help them to solve the main challenges in the potato netchain. Farmers mentioned the names of individuals or organisations that had been helping them to deal with challenges. We subsequently interviewed those individuals or organisations regarding the roles they had played. For all interviews we used a check list with roles extracted *a priori* from the ambidexterity literature, and augmented this list with new and more specific roles which emerged from the interviews.

3.2.2.2 Second phase of data collection

In October 2011, one year after the first phase of data collection, we convened focus groups with farmers and other stakeholders for each case. We presented the trajectory of innovation (a result of the first phase of data collection) to the focus group and discussed our description of the innovation process. We asked participants to observe the trajectory and confirm or modify the activities, challenges and the facilitation roles played by some organisations. A further aim of the

second phase of data collection was to continue tracking how innovation networks had been tackling challenges since the first phase of data collection.

3.2.3 *Analytical approaches*

We used the data collected in the first and second phase of data collection to identify temporal, contextual and structural challenges in the innovation process, and the roles played to tackle them. We identified the challenges and stakeholders in each case, and tracked the most relevant roles and by whom (organisations, teams, association, individuals, etc.). We grouped the stakeholders according to their layer in the netchain, and assessed how intensely each stakeholder group played a certain role, comparing differences in stakeholders and roles between the two cases in each country. We constructed an innovation trajectory with an axis representing the history through time of the producer organisation and associated innovation networks. We annotated this trajectory with the most relevant activities over the innovation process and the challenges (Van de Ven et al., 1999).

We used the following protocol to analyse and annotate the trajectories:

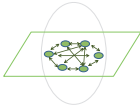
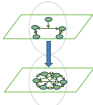
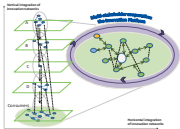
For temporal challenges we assessed how the timing of the process was managed (or not), and by whom. We paid particular attention to the mechanisms to foster dynamism in the process (investigating stages of *exploration* for creating new ways of doing things; or/and stages of *exploitation* for the consolidation of capabilities).

For assessing the management of structural challenges, we tracked the roles played by stakeholders that influenced organisational relationships (ORs) and facilitated the horizontal, vertical and cross-network integration of the netchain. We indicated on the innovation trajectories the roles influencing ORs, and characterised the ORs that emerged in the innovation process according to their formality and whether they resulted in reciprocal, sequential or pooled interdependencies (Thompson, 1967) among the members of the innovation network (Table 3.1). Tracking the ORs at different stages of the process allows us to observe the evolution of ORs and identify exploratory and exploitative phases of the innovation process. Contractual relationships

Stakeholder roles for fostering ambidexterity in Sub-Saharan African agricultural netchains

were used as indicators of informal and formal ORs in addition to project documents and the testimonies of stakeholders.

Table 3.1. Organisational relationships in netchains

a. Relationships involving stakeholders playing roles to facilitate horizontal integration of the innovation networks	
	<p>We marked interdependencies as pooled (---) when there was facilitation of collaborative ORs, without formal agreement, e.g. peer-to-peer collaborative relationships. We marked interdependencies as reciprocal (↔) when there was a more formal agreement, e.g. peer-to-peer lending in an agricultural cooperative (Pollet, 2009), peer to peer knowledge sharing in communities of practice.</p>
b. Relationships involving stakeholders playing roles to facilitate vertical integration of the innovation networks	
	<p>We marked interdependencies as sequential (↓) when there was facilitation of a hierarchical formal relationship among sequentially interdependent stakeholders, at different layers of the netchain. For instance, the role played by an organisation to link potato producers to potato chip processors (Cromme et al., 2010).</p>
c. Relationships involving stakeholders playing roles to facilitate both horizontal and vertical integration of the innovation networks	
	<p>We marked simultaneous facilitation of ORs for pooled (---), sequential (↓) and reciprocal (↔) interdependencies across multi-level networks of the netchain. These relationships are commonly found in multi-stakeholder innovation platforms (Thiele et al., 2011).</p>

To assess the management of contextual challenges, we analysed the roles played by stakeholders to solve problems within the environment in which innovation networks were embedded, comparing in detail cases from the same contexts (countries). Ambidexterity is a capability to tackle simultaneously the dynamics of the environment and its multidimensional boundaries (cultural, political, institutional, physical, etc.) to aim for better and amicable environment for exploration and exploitation.

3.3 Results

3.3.1 Challenges over the innovation process

Respondents reported various challenges but we found little difference between the challenges encountered by potato netchain actors in the two case studies in each country. However, there was some variation in challenges among the three different countries, and not just the contextual challenges that we had expected (Table 3.2).

Structural challenges common to the three countries were the lack of knowledge of natural resource and crop management, lack of technologies, and lack of information for producers on market demands and prices, all of which combined to reduce potato productivity. Farmers also reported having poor linkages to external actors or other stakeholders related to the potato netchain. Contextual challenges encountered in all three countries were the limited capacity of potato producers to access credit due to a lack of collateral and to pay back loans. Potato yields were also reduced in all three countries by diseases, with bacterial wilt (caused by *Ralstonia solanacearum*) a particular problem. Poor infrastructure was seen as a challenge in Uganda and DR Congo but less so in Rwanda where the distances to major markets were shorter and road infrastructure was better. Regarding temporal challenges, timing problems were not mentioned by the respondents, but we observed that dynamic markets and changing consumer demands were temporal challenges in the potato netchains in both Uganda and Rwanda. We now discuss the challenges that were particular to each country.

3.3.1.1 Challenges in Kabale district, Uganda

In Uganda the challenges of managing the timing of the innovation process were intrinsically linked to the need to successfully address local contextual challenges. In Nyabyumba (B) the temporal challenge for farmers was to produce sufficient quality and quantity of potatoes at specific times to comply with the terms of a contract with a restaurant chain. Producers in Bufundi United (A1) faced a similar temporal challenge to produce specific quantities at specific times for a potato distributor.

A structural challenge that affected both cases at the beginning of their innovation trajectories was that farmers were not working collectively for producing and marketing potatoes, and they were not organised as a producer organisation.

Contextual challenges particular to Uganda were of an institutional nature like competing claims for land between agriculturalists and livestock owners (in Bufundi United), as well as the lack of implementation of national policies and local bylaws on potato disease mitigation. However, other contextual conditions were amicable to innovation like the opportunities afforded by the East African Common Market, the existence of national policies that support modernisation in agriculture (Asiimwe and Musisi, 2007) (despite poor operationalisation), the existence of microfinance facilities like Savings and Credit Cooperatives (SACCOS) and a good information and communication technology (ICT) infrastructure that facilitated the connectivity of farmers with the use of mobile phones (Asiimwe and Musisi, 2007).

3.3.1.2 Challenges in Musanze district, Rwanda

Potato is a very important crop in northern Rwanda, and the main source of income for many farmers. Temporal challenges revolved around the need of farmers to resolve the lack of clean seeds and other issues in a timely manner to comply with markets and consumer demands.

Farmers faced fewer structural challenges than in Uganda due to their membership of farmer associations which provided access to training and technical support. Association membership was a common channel for farmers to access land and other benefits from the government and NGOs (Bingen and Munyankusi, 2002). A comparative advantage for Rwandese farmers was a strong national umbrella farmer federation (Imbaraga) that supported farmers, as part of an important presence of the cooperative movement in this country (Pollet, 2009). In common with Ugandan farmers, a crucial structural challenge that hindered the possibility for farmers to make potatoes a successful enterprise was not having access to technologies, particularly clean (i.e. disease-free) seeds, that resulted in the production of poor quality potatoes. Land scarcity, with small plots for producing potatoes was a particular contextual challenge in Rwanda and implied

that some form of collective action was required to aggregate production to meet market and transporter demands.

3.3.1.3 Challenges in Rutshuru territoire, DR Congo

The cases in DR Congo were examples of resilient innovation networks to cope with more complex challenges compared to Uganda and Rwanda. In DR Congo, temporal challenges were dominated by the stages of the civil war that highly affected collective efforts. In the first phase of data collection, farmers mentioned that they were in a post-war period, restarting farming activities. In 2012, the war started again and farmers were displaced to neighbouring countries. For both the Muungano (A3) and the Gamaru (D) farmer groups the conditions were very complex and sub-optimal for making the potato enterprise a success. The main contextual challenge was the civil war and a lack of trust, which also caused structural challenges affecting the organisation and stability of the innovation network. The poor reputation of potatoes was a contextual challenge that reduced the bargaining power of farmers to negotiate the price with traders from the nearest city of Goma. Nevertheless, farmers had some opportunities to explore the market in Kinshasa (the capital city of DR Congo), where potatoes were expensive and considered a luxury. Local processors were interested in buying potatoes from smallholder farmers to exploit this market opportunity, but bad roads and long distances to transport to Kinshasa hindered this business option.

Table 3.2. Challenges reported by key informants per country

Country - district	Uganda, Kabale: Cases A1 and B	Rwanda, Musanze: Cases A2 and C	DR Congo, Rutshuru: Cases A3 and D
Temporal challenges	<ul style="list-style-type: none"> Delays in solving local issues affect the business performance of the potato netchain and diminish business opportunities Comply with timing in MSIP Action plans Comply with delivery schedule as part of contract farming React to (and anticipate) changes in local potato market requirements (e.g. size, dry matter content, harvest date) 	<ul style="list-style-type: none"> The innovation network needed to solve issues such as lack of clean seeds in a timely manner since potatoes is a very important crop in Rwanda, main source of income for many farmers Comply with timing in MSIP Action plans React to (and anticipate) changes in local potato market requirements (e.g. size, quantity, harvest date) 	<ul style="list-style-type: none"> War dictated the timing of the innovation process, stability needed for the innovation network to conduct activities in the netchain was interrupted, affecting the process and its outcomes. Comply with timing in MSIP Action plans React to (and anticipate) changes in local potato market requirements (e.g. starch content, quality)
Structural challenges	<ul style="list-style-type: none"> Potatoes produced and marketed by individual farmers Farmers lack information on markets and prices Farmers have limited bargaining power Few initiatives to improve linkages among actors of the potato netchain Poor farmer organisation makes collective marketing difficult Limited physical and economic access to potato seeds and fertilisers Limited knowledge and diffusion of soil erosion, soil fertility management and crop disease management 	<ul style="list-style-type: none"> Potatoes marketed mainly by individual farmers Farmers lack information on markets and prices Farmers have limited bargaining power Resistance to use improved potato varieties Limited knowledge and diffusion of crop disease management Limited access to clean potato seeds and inputs Poor linkages to other actors of the potato netchain 	<ul style="list-style-type: none"> Potatoes produced and marketed by individual farmers Farmers lack information on markets and prices Farmers have limited bargaining power No initiatives to improve linkages among actors of the potato netchain Poor farmer organisation makes collective marketing difficult Limited physical and economic access to potato seeds and fertilisers Limited knowledge and diffusion of and crop management Few netchain actors in general

Contextual challenges	<ul style="list-style-type: none"> • Competing claims on use of land • Soil infertility and erosion • Production of poor quality potatoes due to diseases • Farmers lack collateral to access credit • Farmers lack financial capacity to respond to credit • Lack of trust among local population • Corruption, governance problems • No operational policies • Poor road infrastructure and high transport costs 	<ul style="list-style-type: none"> • Land scarcity, small plots for producing potatoes • Production of poor quality potatoes due to diseases • Imbalance in bargaining power • Farmers lack collateral to access credit • Farmers lack financial capacity to respond to credit 	<ul style="list-style-type: none"> • Land scarcity, small plots for producing potatoes • Unpredictable climate • Civil war leading to forced displacement • Poverty • Low levels of trust • Soil erosion • Production of poor quality potatoes due to diseases • Farmers lack collateral to access credit • Farmers lack financial capacity to respond to credit • Poor reputation of potatoes from this area • No access to ICTs like mobile phones • Corruption, governance problems • No written policies • Poor road infrastructure and high transport costs
Favourable contextual conditions and opportunities	<ul style="list-style-type: none"> • Microfinance facilities like Savings and Credit Cooperatives (SACCOS). • Written policies • Connectivity of farmers using mobile phones. • Cross-border trade with Rwanda and East African Common Market 	<ul style="list-style-type: none"> • Organised farmers. Cooperatives (e.g. Imbaraga). • Increasing financial opportunities • Access to technologies and inputs, coordinated through farmer groups (e.g. Imbaraga national federation). • Policies written and more operational • Government tackling corruption • Good infrastructure, no high transport costs. • Connectivity of farmers using mobiles phones. • Cross-border trade with Uganda and East African Common Market 	<ul style="list-style-type: none"> • Market opportunities in Kinshasa due to large population and high prices of potatoes. • Cross-border trade with Uganda and Rwanda and East African Common Market

3.3.2 Roles by stakeholder to tackle challenges over the innovation process

Ambidexterity is the dynamic capability to manage temporal, structural and contextual challenges that exploration and exploitation entail in practice. Consequently, for both potato netchains in each country we observed which kinds of stakeholders played which roles to tackle challenges.

We first refer to a summary showing the intensity of the activity for each stakeholder group, followed by an analysis of the innovation trajectory and the roles of different stakeholders. Intensity is determined by whether a particular role is a core activity or responsibility of a particular stakeholder group, or only a side activity; the tones of grey in tables 3.3, 3.4 and 3.5 relate to the average intensity for all stakeholders in a particular stakeholder group. Dark grey signifies that the role is core for all stakeholders in the group, and white signifies that none of the stakeholders in the group play that particular role.

3.3.2.1 Stakeholder roles in Kabale district, Uganda

Potato netchains in Bufundi United (A1) and Nyabyumba (B) comprised nine and eight stakeholder groups of the potato netchain respectively, with similar configurations of stakeholders participating in multi-stakeholder platforms (Table 3.3). The MSIP fora coordinated the activities playing multiple roles with high intensity. Each forum orchestrated the roles played by stakeholders in a participatory and collective manner, taking into account the specialisation of stakeholders in certain roles, e.g. *sharing information* by the data manager in Bufundi United, or *formalisation of agreements* by the retailer and service provider in Nyabyumba. Some roles, like *implementing innovations* and *lending capital for innovations* were not played directly by the MSIP but facilitated to be played by specialist stakeholders.

Table 3.3. Roles played by stakeholder groups in the Bufundi United MSIP and the Nyabyumba cases in Uganda.

Case Study	A1 – Bufundi United								B - Nyabyumba								
Stakeholder groups (# of stakeholders)	MSIP Forum (4)	Farmer (10)	Distributor / Wholesaler (2)	Researcher (2)	Policy Maker (1)	Seed Processor (1)	SSACP Data Manager (1)	SSACP Task Force Leader (1)	Financial Service Provider (1)	ERI Consortium (1) (2003)	Farmer (13)	Researcher (1)	Seed Producer (1)	Extension Agent (1)	Retail / Food Outlet / Processor (1)	Service Provider (1)	Farmer Association (2)
Roles																	
Develop action plan collectively																	
Follow up and re-frame plans																	
Participatory decision making																	
Administrative management																	
Explore innovations collectively																	
Share information																	
Share knowledge																	
Facilitate communication among actors																	
Build network for innovation																	
Invite new stakeholders																	
Link relevant stakeholders																	
Match common interests																	
Facilitate access to technological innovations																	
Implement innovations																	
Link farmers to markets																	
Add value product and services																	
Formalise agreements																	
Diagnose challenges																	
Mediate in conflicts																	
Lend capital for innovations																	
Design rewards and sanctions																	
Influence policies																	

Different tones of grey represent the intensity of how the roles are played to tackle temporal, structural and contextual challenges.

All of the *a priori* identified roles were played by at least one stakeholder in Bufundi United, while in Nyabyumba there was no stakeholder *lending capital*, and only low intensity by farmers to *implement innovations*. This is due to the longer trajectory that had previously taken place in Nyabyumba. Nyabyumba farmers were in another stage of the innovation process, mainly exploiting their capabilities doing contract farming. Therefore, they had fewer connections to other stakeholders of the netchain compared to when they were part of the Enabling Rural Innovation Consortium, and also less emphasis on the *participatory decision-making* role.

For overcoming temporal challenges, the management design of the IAR4D intervention in Bufundi United included monthly meetings of the MSIP to discuss challenges, develop action plans and re-frame these according to new developments. This timing of the innovation process fostered simultaneously stability and consolidation of capabilities (exploitation), and also exploration. A monitoring and evaluation committee was in charge of tracking the process. Similarly, the Nyabyumba farmers managed their timing when part of the Enabling Rural Innovation (ERI) consortium (Figure 3.2). Before 2003 their timing was managed by previous interventions. When consolidating as a business network, their timing was coordinated according to the contracts with the retailer, for the delivery of potatoes in a timely manner.

To manage structural challenges, the Bufundi United MSIP and the Nyabyumba ERI consortium (a non-IAR4D MSIP) played similar facilitation roles. At the beginning of the innovation process of Nyabyumba farmers (Figure 3.2), there was scattered marketing of potatoes, followed by collective production and marketing of potatoes as part of a Farmer Field School initiative. These farmers had therefore already developed some organisational and other capabilities when they became part of the ERI consortium, and after one year they had explored market opportunities and signed a contract to supply a restaurant chain. Farmers in Bufundi in contrast had little experience of collective marketing and production when they were invited to participate in the IAR4D MSIP (Figure 3.3). In both cases the MSIP played the role to organise

small innovation networks as teams or communities of practice for crop management and exploring new ways to organise the potato netchain. The members of these communities of practice sustained reciprocal interdependencies. At this point in the trajectory a lack of linkages to other stakeholders was a structural challenge because the horizontal integration of the innovation network was insufficient to overcome collective contextual challenges like seed potatoes free of bacterial wilt. The roles of research organisations, extension agents and seed producers were crucial in the facilitation of clean seeds, training and linking farmers to stakeholders at other layers of the netchain. Researchers also trained the Bufundi United producers in value addition technologies and coordinated the Open Distance Learning Network for farmers to access information using mobile phones and share information on prices and markets. The situation in Nyabyumba was slightly different because the farmers managed the innovation process themselves and emphasised the important proactive leadership role played by the president of the farmer association in collaboration with farmer committee members in linking with relevant actors when needed. In both cases, a combination of reciprocal, sequential and pooled ORs were observed over time with stakeholders at various levels (Figure 3.2 and Figure 3.3), but in Nyabyumba the process was longer than in the IAR4D MSIP.

Innovation networks were consolidated into business networks in both cases, and after developing their organisational, knowledge, natural resource management and production capabilities Nyabyumba farmers became part of a Saving and Credit Co-operative Society (SACCO). In order to grow their business capacity and overcome the contextual challenge of accessing credit the Bufundi United MSIP made an innovative cross-boundary partnership with a financial organisation from DR Congo. A major contextual challenge was the competing claims on land use with pastoralists and potato growers. The MSIP mediated to solve the conflict and played an advocacy role in the process of writing by-laws. However, the mediation was not effective since more operational decisions needed to be made by higher government representatives to solve the conflict.

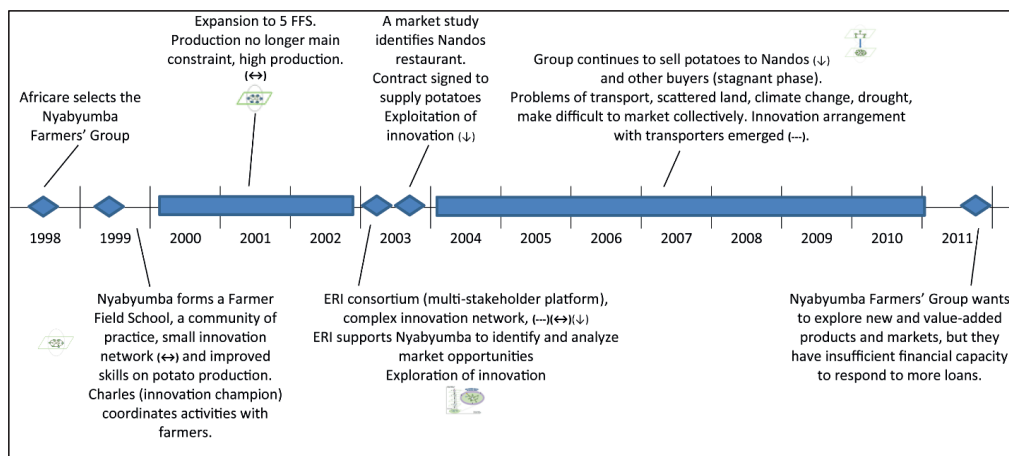


Figure 3.2. Innovation trajectory of the Nyabyumba group (B)

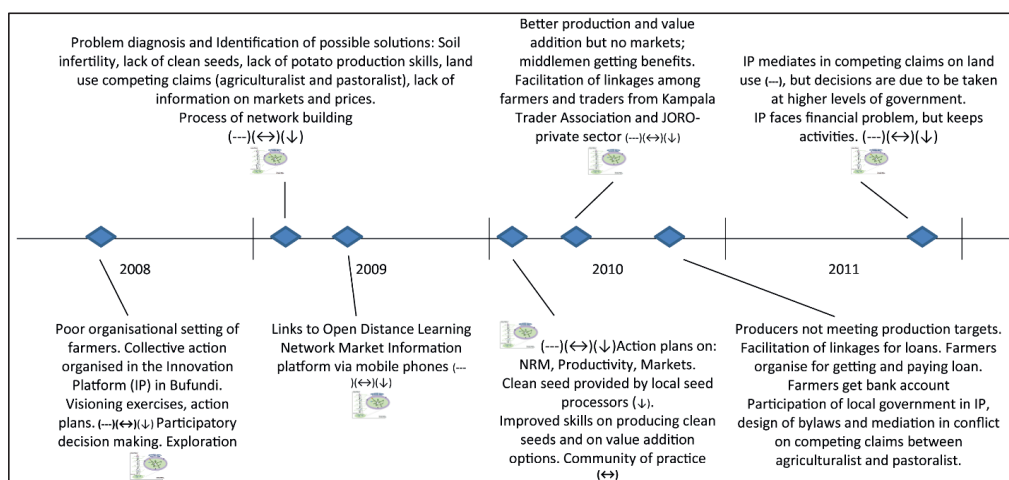


Figure 3.3. Innovation trajectory of the Bufundi United Multi-Stakeholder Innovation Platform (A1)

3.3.2.2 Stakeholder roles in Musanze district, Rwanda

Potato netchains in Gataraga (A2) and Nyange (C) were composed of nine and three netchain stakeholder groups respectively (Table 3.4). The Gataraga netchain covered a diverse group of stakeholders and the role of *lending capital* was not played by a Rwandese stakeholder, but instead by MECREGO a partner organisation of the MSIP from DR Congo. In contrast in

Nyange there were far fewer roles that were played and more effort was directed by stakeholders to implementing innovations. Many roles were played by the forum of the Gataraga MSIP, but in both cases the extension agent was dominant for sharing knowledge and information, with the agent particularly important in Nyange for facilitating communication and network building. Private sector processors and retailers collaborated strongly in Gataraga for linking farmers to markets and subsequently formalising agreements. Abahujumugambi farmers in Nyange took fewer roles than in Gataraga and were more focused on exploring innovations collectively, implementing innovations, sharing knowledge and sharing information, using the didactic materials in the local language developed by CIP.

Temporal challenges were managed differently in the two Rwandan potato netchains. In Gataraga the stages of exploration and exploitation were fostered simultaneously and there were action plans which were reviewed and adjusted every month. Abahujumugambi farmers in Nyange were participating as part of a conventional agricultural R&D approach, focused on the diffusion of the positive selection technology (Figure 3.4) to address the contextual challenge of lack of clean seeds. Consequently, this R&D intervention design had a fixed and short-term agenda with an emphasis on developing and exploiting capabilities for implementing a specific technology to tackle a specific challenge.

The structure of the netchain in Nyange was limited to just two layers of the potato netchain, with a community of practice of farmers integrated vertically to a lead organisation (CIP) via an extension agent (see Figure 3.4). This was an example of a hierarchical formal relationship among sequentially interdependent stakeholders, at different layers of the potato netchain. No linkages to markets were being facilitated and innovation networks were not consolidated into business networks, with just a handful of farmers selling clean seeds to their neighbours. The structural challenges of lack of access to technologies and inputs were being successfully tackled, but there was no attempt, or remit, to address the lack of information on markets and prices.

Table 3.4. Roles played by stakeholders in the Gataraga MSIP and the Abahujumugambi cases in Rwanda.

Case Study		A2 – Gataraga							C – Abahujumugambi				
	Stakeholder groups (# of stakeholders)	MSIP Forum (5)	Farmer (6)	Distributor / Wholesaler (1)	Researcher (1)	SSACP National Data Manager (1)	SSACP Task Force Leader (1)	Retail / Food Outlet / Processor (1)	Extension Agent (1)	Financial Service Provider (1)	Farmer (27)	Researcher (1)	Extension Agent (1)
Roles													
	Develop action plan collectively												
	Follow up and re-frame plans												
	Participatory decision making												
	Administrative management												
	Explore innovations collectively												
	Share information												
	Share knowledge												
	Facilitate communication among												
	Build network for innovation												
	Invite new stakeholders												
	Link relevant stakeholders												
	Match common interests												
	Facilitate access to technological innovations												
	Implement innovations												
	Link farmers to markets												
	Add value product and services												
	Formalise agreements												
	Diagnose challenges												
	Mediate in conflicts												
	Lend capital for innovations												
	Design rewards and sanctions												
	Influence policies												

Different tones of grey represent the intensity of how the roles are played to tackle temporal, structural and contextual challenges

Farmers in Gataraga also benefitted from training in positive selection technology (Figure 3.5), using the specialised knowledge and didactic materials of CIP, but the MSIP forum was particularly active in linking farmers to markets and to stakeholders at other layers of the potato netchain. Farmers were introduced to ‘e-soko’, a mobile-phone information and communication system used to access market information, and were successfully consolidated into business networks selling potatoes to hotels and the Nakumati supermarket in Kigali. The MSIP enhanced their capacity to monitor their own progress and evaluate themselves, and to keep track of information in the MSIPs, by keeping records on productivity and profit, as part of a data management strategy facilitated by the national data manager and the monitoring and evaluation committee.

A local extension agent who facilitated activities in the Gataraga MSIP co-operated with farmers to explore and design the packaging of potatoes using no-cost locally sourced banana fibre, a value addition that urban consumers were willing to pay for. The roles of community champions were also very important in Gataraga where a female champion farmer became a trader and overcame contextual challenges of land scarcity by aggregating potatoes from 300 participating farmers, gaining bargaining power and better prices for all producers.

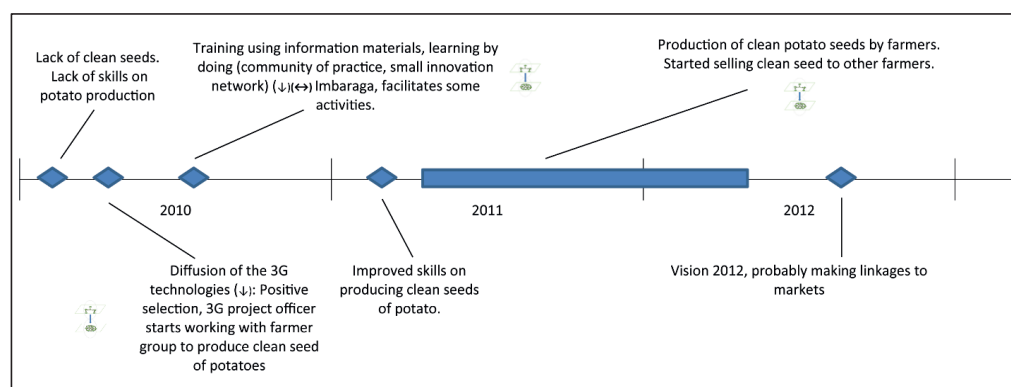


Figure 3.4. Innovation trajectory of the Abahujumugambi group (C)

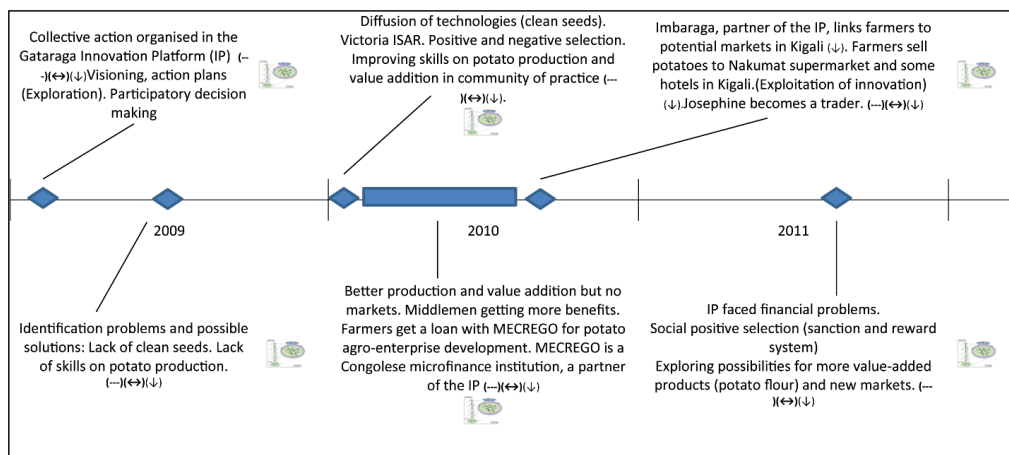


Figure 3.5. Innovation trajectory of the Gataraga Multi-Stakeholder Innovation Platform (A2)

3.3.2.3 Stakeholder roles in Rutshuru territoire, Democratic Republic of the Congo

We observed that farmers of the Gamaru group (D) were not connected to external stakeholders (Table 3.5) apart from an extension agent, a member of the local-small innovation network, who facilitated collective action to tackle challenges. Farmers commented that, given the tense environment in Rutshuru, it was difficult to attract other service providers willing to work in the area. In contrast the Muungano farmers in Kisigari (A3) were connected to diverse stakeholders at nine netchain layers. As in Uganda and Rwanda, the MSIP forum orchestrated the facilitation and roles played by stakeholders. The forum played roles for sharing information and knowledge, facilitated by the Sub-Saharan Africa Challenge Program national data manager, who requested the cooperation and facilitation of other more specialised stakeholders when needed (for instance, extension agents for the diffusion of technological packages). Financial services were provided and agreements formalised with end users. Specialised service providers in the MSIP played direct roles in the netchain like a financial service provider (MECREGO), which provided loans to farmers not only in the Muungano MSIP in DR Congo but also to MSIPs in Uganda and Rwanda. Roles played by stakeholders were facilitated at a national level by an NGO (Diobass), which centralised the resources and services for farmers. A farmer union

for the advocacy of farmer rights (Sydip) played an important role on organising farmers for collective marketing.

Middlemen were a type of service provider mentioned, with whom farmers made linkages.

Sometimes the bad reputation of potatoes of Rutshuru was used for opportunistic behaviour.

For the famers in Gamaru, there was no strategy to manage timing, and decisions were dictated by the influence of the civil war; in periods of relative peace farmers kept exploring new ways of doing things in their community of practice. In the Muungano MSIP the stages of exploration and exploitation were fostered simultaneously and there were actions plans for tackling challenges, these plans were reviewed and adjusted every month.

Low levels of trust and high migratory movements made it difficult for the Gamaru farmers to overcome the structural challenges of poor organisation of farmers to improve production and to make potatoes a business. Farmers in Gamaru had been growing potatoes individually just for subsistence and working in isolation. Production, natural resource management, crop management, and marketing practices were based on individual exploration and tradition, and were limited by a lack of agricultural inputs such as clean seeds. Being organised as a group or team was important to tackle contextual challenges but external facilitation was not given, even in the post war period (in 2010). Farmers said that an extension agent used to go to the province but that because of the war people no longer received visits, they therefore relied on the knowledge shared by a local leader, an agronomist (Figure 3.6) and their peers. However, farmers were unable to overcome challenges like soil erosion, and access to clean seeds and other inputs.

Table 3.5. Roles played by stakeholders in the Muungano MSIP and the Gamaru farmer group cases in DR Congo.

Case Study	A3 – Muungano								D - Gamaru		
Stakeholder groups (# of stakeholders)	MSIP Forum (4)	Famer (5)	Famer Union (1)	Researcher (1)	SSACP National Data Manager (1)	Financial Service Provider (1)	Extension Agent (2)	Retail / Food Outlet / Processor (1)	Diobass: Local NGO (2)	Famer (7)	Extension Agent (1)
Roles											
Develop action plan collectively											
Follow up and re-frame plans											
Participatory decision making											
Administrative management											
Explore innovations collectively											
Share information											
Share knowledge											
Facilitate communication among actors											
Build network for innovation											
Invite new stakeholders											
Link relevant stakeholders											
Match common interests											
Facilitate access to technological innovations											
Implement innovations											
Link farmers to markets											
Add value product and services											
Formalise agreements											
Diagnose challenges											
Mediate in conflicts											
Lend capital for innovations											
Design rewards and sanctions											
Influence policies											

Different tones of grey represent the intensity of how the roles are played to tackle temporal, structural and contextual challenges.

The facilitation of the Kisigari MSIP was important for tackling structural challenges and the MSIP helped to rebuild social structures after the war by connecting various stakeholders in DR Congo and regionally. In common with the MSIPs in Uganda and Rwanda, linkages were facilitated between farmers and stakeholders at different layers of the netchain (Figure 3.7). Diobass, a non-governmental organisation, played important roles facilitating farmers in Kisigari to tackle structural challenges in the Muungano MSIP, organising the farmers to produce and market potatoes collectively in collaboration with other stakeholders. For instance, INERA, SYDIP (farmer union), CIAT-TSBF (International Center for Tropical Agriculture), the Goma Volcano Observatoire and Diobass worked together to help farmers to improve their production and post-harvest management of potatoes, for complying with quality and quantity standards. Farmers also got access to technologies for improving the productivity of potatoes, like clean seeds (variety *Victoria*) and were trained in crop management.

Lack of information on markets and prices was a structural challenge that was only partially solved in the MSIP. Farmers could not afford ICTs like mobiles phones hindering price negotiations with middlemen and reducing the bargaining power of farmers. The innovation networks did not succeed as business networks in the potato netchain, mainly because of the effects of the civil war but also because other factors like the poor road infrastructure, which together hindered the exploitation of the business opportunities that arose with local processors. Finally, in 2012 the war started again and many farmers were displaced to Uganda and other neighbouring countries.

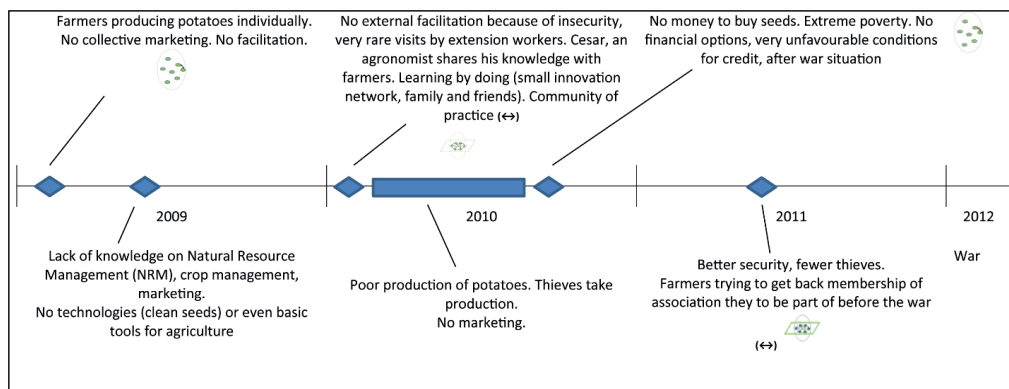


Figure 3.6. Innovation trajectory of the Gamaru farmer group (D)

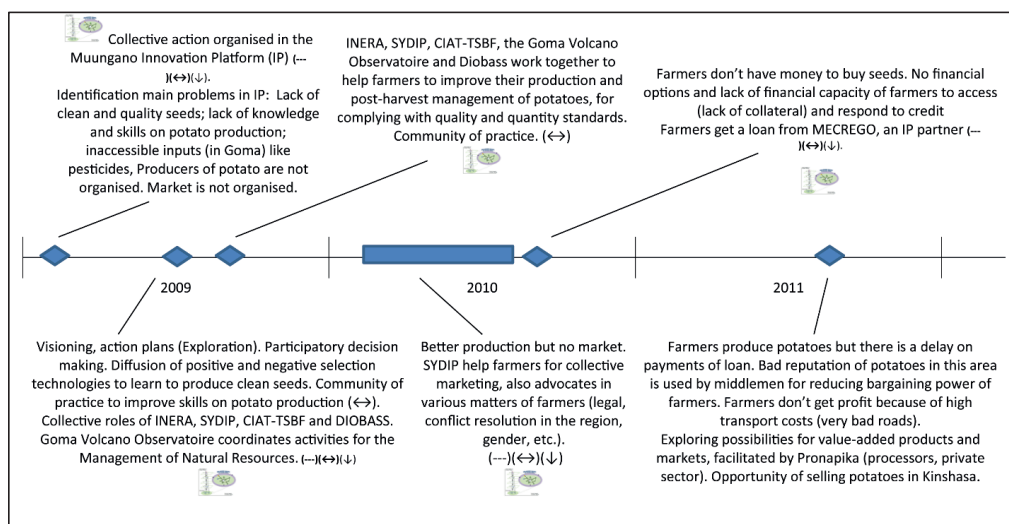


Figure 3.7. Innovation trajectory of the Muungano Multi-Stakeholder Innovation Platform (A3)

3.4 Discussion and Conclusions

We have presented what roles are played and by whom to foster ambidexterity in netchains for tackling challenges faced by smallholder farmers in Sub-Saharan African countries. We have identified traditional roles played by traditional actors, but we have also identified how roles are played by civil society actors, which reflects the new dynamics of how exploration and exploitation are organised in the open innovation paradigm. Innovation networks offer new ways

of producing knowledge and allow diverse stakeholders to tackle the contextual, structural and temporal challenges faced by smallholder producers and other stakeholders in Sub-Saharan Africa. Roles played by a diversity of stakeholders working in synergy for collaboration and cooperation within the netchain fostered multiple capabilities of the innovation network, particularly in multi-stakeholder innovation platforms. We have shown that ambidexterity was a dynamic managerial capability of innovation networks in multi-stakeholder innovation platforms in the potato netchain. This ambidexterity implied facilitation and design of management mechanisms to balance simultaneously exploration (of issues related to crop and disease management for instance) and exploitation (e.g. bulking, grading and packaging). Orchestrating collective action among the multiple layers of the netchain required a dynamic meta-governance of the innovation networks. The outcomes of the facilitation and management generally resulted in the solution of various collective issues and in some cases in the consolidation of business networks and the emergence of multi-stakeholder cooperatives (Figure 3.8).

3.4.1 Management designs for tackling collective challenges

From the major characteristics of our six case studies (Table 3.6) we can identify three types of management designs of innovation networks for tackling collective challenges. The management design reflects and limits the complexity of the challenges that netchains face:

(a) Exploratory or exploitative management designs for small innovation networks, which foster mainly knowledge and information sharing capabilities (Case D Table 3.6). We found that in contrast to other experiences in developed countries (e.g. Gilsing and Nooteboom, 2006) small innovation networks are not just for exploration. The small networks can be exploitative when members sustain mutual interdependence, for instance, at the farmer level in the cases of multi-stakeholder innovation platforms (MSIPs), farmers united with their peers to work as collateral to obtain credit from a financial institution (Cases A1, A2, A3 Table 3.6). Roles are mainly played by leaders, champions and teams (i.e. communities of practice) for exploring (informally) or for exploiting (formally) the capabilities.

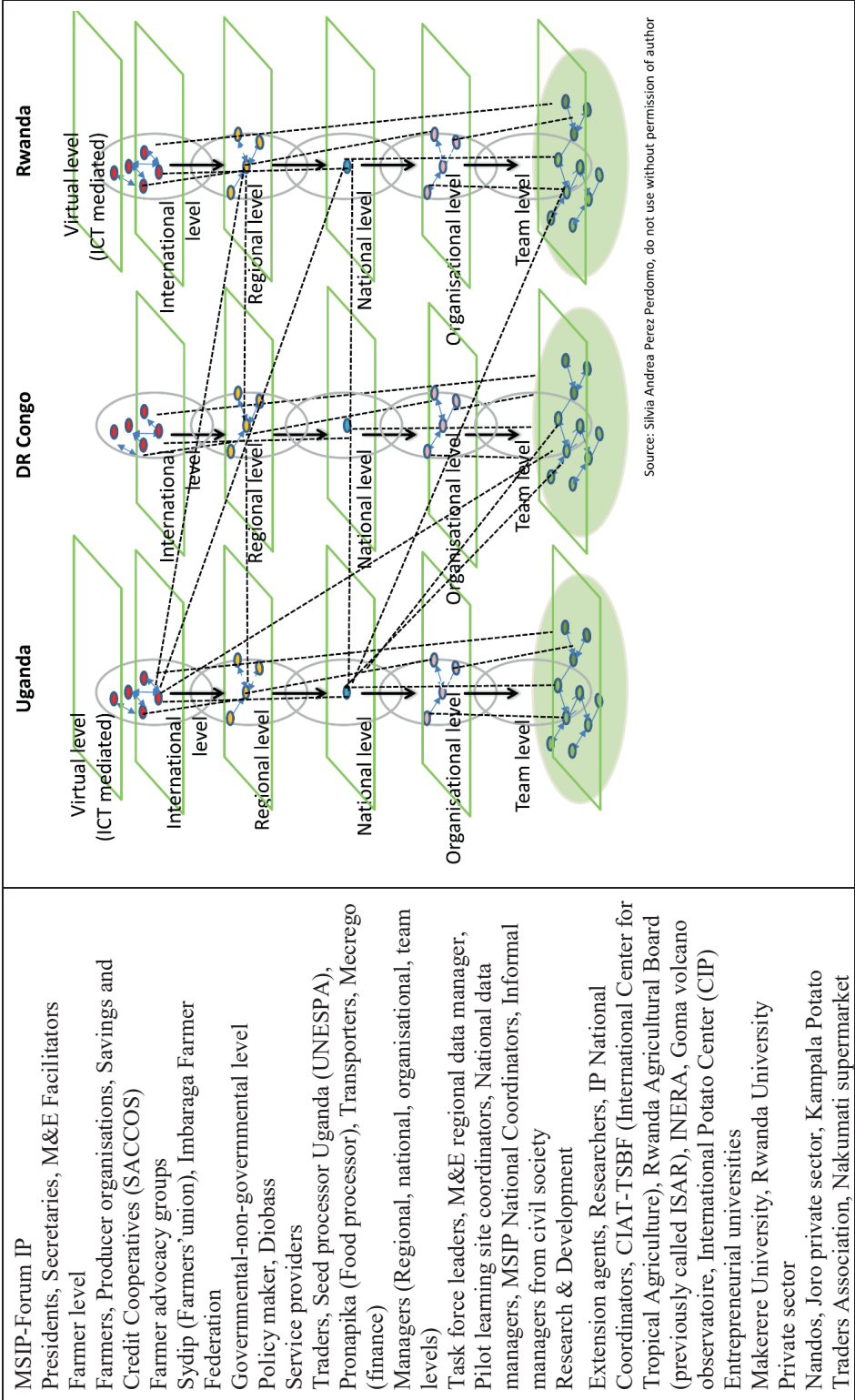


Figure 3.8. Pooled, reciprocal and sequential interdependencies among stakeholders at various levels in emergent multi-stakeholder cooperatives.

For tackling structural challenges, leaders or champions organise activities for strengthening reciprocal interdependencies among members of the innovation network (horizontal integration of the innovation networks), who are generally members of the family and neighbours. The management structure of the network is democratic and horizontal. The role of teams was important for exploring new ways of doing things and learning, but also to exploit the capabilities of the small innovation networks of peers or communities of practice at the beginning of the innovation process for organising for collective action.

However, despite the important role of teams and local leadership for exploring new ways of doing things, too much exploration without facilitation and proper management just makes farmers stagnant in the cycle of innovation, reinforcing the circle of poverty. The problem with this mode of management for structural challenges is that these small networks do not have the capacity to comply with high production volumes generally demanded to benefit from economies of scale.

Temporal challenges in this design are managed in a flexible sometimes very resilient manner, without action plans or set goals that orient collective action. Similarly, contextual challenges are managed with little planning or possibility of mitigation (for instance, by changing policies), and collective efforts are mainly focused on adaptation and exploring new ways of doing things, which is insufficient to consolidate business opportunities.

Stakeholder roles for fostering amidexterity in Sub-Saharan African agricultural netchains

Table 3.6. Summary of major characteristics of potato netchain case studies

Case	A1 – Butundi United	A2 – Gataraga	A3 – Muungano	B – Nyabyumba		C – Abahujumugambi	D – Gamaru
				MSIP in 2003	2010-2011 Contract farming		
Stakeholders involved: netchain levels	MSIP forum Producer organisation Traders Service providers Extension agents Retail/food/outlet processor Entrepreneurial university Researchers IAR4D Policy maker National and regional task force leaders (managers) Informal managers civil society Other partner organisations	MSIP forum Producer organisation National farmer federation Traders Financial service provider Extension agents Retail/food/outlet processor Entrepreneurial university Researchers IAR4D National and regional task force leaders (managers) Informal managers civil society Other partner organisations	MSIP forum Producer organisation Traders Financial service provider Extension agents Retail/food/outlet processor Local NGO Researchers IAR4D National and regional task force leaders (managers) Informal managers civil society Other partner organisations	Enabling Rural Innovation (ERI) Consortium-platform Non-governmental organisation Producer organisation Researchers ERI Project managers Informal managers (civil society) Other partner organisations Retailer	Producer organisation SACCO Informal managers (civil society) Transporter Retailer	Farmers Extension agent Researcher	Farmers Extension agent
Main roles	Multiple roles of stakeholders, collective actions orchestrated by forum of MSIP.	Multiple roles of stakeholders, collective actions orchestrated by forum of MSIP.	Multiple roles of stakeholders, collective actions orchestrated by forum of MSIP.	Multiple roles of stakeholders, collective actions orchestrated by forum of MSIP.	Sharing information, sharing knowledge. Implementing innovations (technological packages). Linking farmers to markets. Formalisation of agreements.	Sharing information, sharing knowledge, implementing innovations (technological packages).	Exploring new ways of doing things collectively, sharing knowledge
Main challenges tackled	Tackling simultaneously temporal, structural and contextual challenges	Tackling simultaneously temporal, structural and contextual challenges	Tackling simultaneously temporal, structural and contextual challenges	Tackling simultaneously temporal, structural and contextual challenges	Mainly structural and contextual	Mainly contextual	Mainly structural-knowledge related challenges
Challenges not tackled	Contextual – competing claims Structural – vertical integration with higher level decision makers	Contextual – sporadic challenges of meeting quantity and quality demands Vertical integration – Strengthen ties with clean seed suppliers	Contextual – Satisfying quantity and quality demands Vertical integration with higher level decision makers to ensure security Horizontal integration with more producers	Contextual – Sub-optimal transportation Structural – sporadic challenges of meeting quantity and quality demands Vertical integration – Strengthen ties with research	Temporal, little vertical integration, many contextual challenges	Temporal timeframe limited by R4D intervention. Structural – no links to markets	Temporal, little vertical integration, many contextual challenges

(b) Exploitative management designs for larger networks are for exploiting the capabilities and scaling innovations, in a more formal manner, generally (but not necessarily) consolidated in written agreements. This management design involves planning to reach some specific goals such as the diffusion of a technology in the case of Abahujumugambi farmers, or for complying with production and quality demands in the case of contract farming of Nyabyumba (Cases B, C Table 3.6). Although agricultural R&D approaches have been criticised for their linearity, we found that the roles of specialised stakeholders are key to solve specific challenges and linearity is sometimes needed to scale-out innovation. In the other cases we also observed that tackling some structural or contextual challenges requires a leading specialised stakeholder. For instance, if the challenge is lack of credit a financial institution – whether a Savings and Credit Cooperative in Uganda or a private sector actor in DR Congo - plays the *Lending capital* role since that is its core function. *Implementing innovations* is a role mainly played by research organisations – like KAZARDI in Uganda, CIP in Rwanda and INERA in DR Congo – that are specialised in the diffusion of technologies. Given the specialised character of an exploitative management design means that stakeholders do not necessarily play roles that are beyond their core function to help tackle other challenges.

In this management design, temporal challenges are managed generally in a fixed and short-term agenda, according to established formal agreements among parties.

Structural challenges are tackled by fostering not only the horizontal, but also the vertical integration of the innovation network. The organisation of these larger networks corresponds to the traditional management structure of the specialised organisation, such as agricultural extension or a financial organisation, with a hierarchical management structure. There are no further linkages to other stakeholders, implying less new knowledge and innovation to trigger exploration.

(c) Ambidextrous management designs for multi-level networks are required for the simultaneous exploration of synergies and exploitation of capabilities. This management design

entails a simultaneous management of structural, contextual and temporal challenges at multiple levels, as observed in the case of multi-stakeholder innovation platforms (Table 3.6 Cases A1, A2, A3 and B, in 2003). In this design farmers are linked to more diverse stakeholders and farmers grow their capabilities by being facilitated by managers that contribute to keeping the innovation process dynamic. To tackle temporal challenges stakeholders must play roles that maintain innovation processes in stages of stability and also in stages of change-flux, keeping the innovation process in a 'dynamic-stability'. For temporal challenges, it is important to have a management design that fosters the exploration of new ways of doing things when the innovation process stagnates, and fosters stages of stability when the innovation process needs to consolidate. Complex challenges require management over short, medium and long term timeframes. In contrast, in the cases without MSIPs there was still a need to manage the timing of activities although the lack of a platform of diverse stakeholders limited these netchains to tackle specific challenges and kept them in explorative (Gamaru, DR Congo) or exploitative (Abahujumugambi, Rwanda) stages of the innovation process. Monitoring and evaluation of the innovation process is an important strategy in MSIPs for managing the timing of activities and avoiding stagnation of the process. Specific roles played by stakeholders to keep the dynamism of the innovation process (temporal mobility) were: developing collectively action plans, follow up and frequent (monthly) re-framing of plans, and participatory decision making.

In MSIPs, innovation networks for exploration and exploitation are orchestrated dynamically by fora (mobile hubs, Pérez Perdomo, 2014), which democratically decide which stakeholders should play which roles for tackling which challenges, organising the netchain through hybrid managerial designs over the innovation process. Different organisations lead the innovation process at different stages according to the challenges for the exploration and exploitation of capabilities of the innovation network.

A common structural challenge in the three countries was the poor linkages between farmers and other stakeholders of the netchain. For tackling such structural challenges, *network building for*

innovation, matching common interests, inviting new stakeholders, and linking farmers to

markets, were important, which fostered horizontal, vertical and cross-network integration of the innovation network.

At the beginning of most of the trajectories a general problem was how to enhance the organisational capabilities of farmers, particularly when they were not organised as a farmer group. Then, the facilitation by community leaders and champions of activities for strengthening their reciprocal interdependencies as part of the horizontal integration of the innovation networks was vital, especially for farmers in DR Congo. The role of teams was also important for exploring new ways of doing things and learning, but also to exploit the capabilities of the small innovation networks at the beginning of the innovation process for organising collective action (Exploratory-exploitative management design for small innovation networks). Horizontal integration via the organisation and mobilisation of communities of practice at different network levels also enhances the movement of knowledge, even leading to the formation of virtually mediated communities of practice using information and communication technologies (ICTs, mainly mobile phones) in combination with traditional communication media.

For fostering the vertical integration in the netchain, there was again a need of some specialised stakeholders leading the process of tackling specific challenges (Exploitative management design). For instance, *lending capital* for innovation was a role which was not directly played within the MSIP in Uganda and Rwanda (cases A1, and A2), but instead by a financial institution partner of the MSIP in DR Congo (A3). *Lending capital* for innovation was crucial given that without investment in services and inputs (e.g. seed), producers would be unable to grow their self-help entrepreneurial capabilities. Another leading role was played by universities (like Makerere in Uganda and Rwanda National University), *facilitating access to technological innovations*, showing a shift in their traditional roles, and emerging as entrepreneurial universities (Ambos et al., 2008).

Cross-network integration was observed in all of the cases with MSIPs, with simultaneous pooled, reciprocal and sequential interdependencies among stakeholders at various levels (Figure 3.8). The organisations that play these roles can be from different netchain layers according to the composition of the netchain, and the specific roles vary according to the context and the maturity of the network. *Network-building for innovation, inviting new stakeholders, linking relevant stakeholders and linking farmers to markets* are roles that foster cross-network integration and boundary spanning.

In relation to roles tackling structural challenges, we found that stakeholders had different incentives for participating in the innovation process so that aligning efforts for collective action was complex. For instance, a seed processor in Uganda manifested his interest in participating in the MSIP but with the clear incentive of collaborating with future potential buyers of seeds. Similarly, a local retailer and processor wished to construct a potato crisp factory in Kabale and their incentive to participate in the MSIP was to contact farmers as potential future suppliers. Meanwhile the local government in Kabale, which is a permanent local actor, had an incentive to contribute to policy development for the benefit of its citizens as well as to oversee the implementation of regulations. To align such a diversity of incentives and interests, the MSIP played a role as an open forum governing the innovation networks at different levels (multi-scalar complex innovation networks), with a dynamic meta-governance (hybrid governance). From the innovation trajectories we observed that the MSIP decided democratically what challenges, where (multi-dimensional boundaries), how (technological, knowledge, institutional capabilities, etc.), when (timing) and with whom exploration and/or exploitation needed to be organised. It also coordinated organisational relationships (pooled, sequential and reciprocal) for simultaneous exploration and/or exploitation over time. The MSIP helped farmers in particular to access resources such as new sources of knowledge, information materials, technology, agricultural inputs, and credit. The MSIP had a knowledge and information management

facilitated for boundary spanning (Kristjanson et al., 2009, Goldberger, 2008), by mobilising communities of practice at different network levels, and dynamically over time.

The cases of IAR4D platforms (cases A1, A2, A3) benefited from regional task managers (from different types of organisations) for coordinating the interfaces between markets, productivity and natural resource management respectively, as well as national managers; both sets of managers tended to be from non-governmental organisations, research institutions and universities. Nevertheless, there was a combination of collective managerial roles played by leaders, champions, teams, and organisations, all as part of innovation networks, which were orchestrated by the forum of the MSIP to keep a balance in the network structures for exploration and exploitation (Structural and knowledge mobility).

The role of public and private partnerships was important for giving space for synergy among the various stakeholders of the netchain. Stakeholders part of innovation networks of such hybrid organisations (like MSIPs) play simultaneously multi-tasking roles (further traditional roles), enhancing more multi-dextrous capabilities (organisational, technological, knowledge, institutional, and financial) to tackle challenges, compared to the innovation networks without MSIPs.

Most importantly, farmers' participation in the innovation process was not restricted to farming activities (exploitation). More inclusiveness of farmers in the innovation process is observed, changing the linearity of the diffusion or implementation of technological packages to a more collective and inclusive network approach. Farmers participated in democratic decision making to organise collective action in order to tackle problems (exploration and exploitation) in synergy with a larger number of stakeholders of the netchain.

We found that contextual challenges are marked by geographical, social, institutional, political, and virtual boundaries (sometimes as barriers, sometimes as enablers) and influence interactions of stakeholders and thus the innovation process and its outcomes. MSIPs not only facilitated linkages among stakeholders of the netchain but, in contrast to the other cases, also managed

contextual challenges, by playing different roles for mobilising the boundaries that limited the collective action of the innovation network.

The most common roles to mobilise the boundaries were: *mediation in conflicts and communication facilitation among actors, formalisation of agreements, influencing policies*, like in the mediation in conflicts in the Bufundi United MSIP, trying to integrate government in the solution of competing claims and facilitating amicable institutional arrangements (e.g. bylaws, or a written MSIP constitution). Also, in the MSIPs a system of sanctions and rewards were in place, like in the Gataraga MSIP where social ‘positive selection’ (learnt from CIP didactic materials to fight bacteria wilt of potatoes) was employed to tackle the entrance of free riders in the network. A similar strategy was observed in DR Congo where the MSIP forum created sanctions to avoid free riders in the MSIP who benefitted from inputs (like trees) without paying membership fees, and applied economic sanctions on members who did not contribute to collective work in the field. The dynamics of innovation networks were embedded in an environment with multi-dimensional boundaries (geographical, virtual, institutional, political, cultural), which marked a barrier or an enabler for exploration and/or exploitation. For instance, the cooperative movement in Rwanda was an enabler or positive factor of the environment that fostered collective action; while in contrast, in DR Congo the environment and its political problems hindered the process of tackling collective challenges. In accordance with Mueller et al. (2013) we found that institutional factors, like national culture had an impact on the benefits of exploration and exploitation, but further research is needed to see to what extent these factors influence the outcome of the innovation process in a developing country setting.

3.4.2 Conclusions

What roles are played and by whom to foster ambidexterity as a capability of innovation networks for tackling challenges faced by smallholder farmers in Sub-Saharan African countries?

Fostering ambidexterity as a dynamic capability of innovation networks for tackling challenges through collective action is a complex task not only for managers but for other stakeholders of the network that aim to tackle challenges in Sub-Saharan Africa.

We observed that the time taken by innovation networks to become business network varies.

Facilitation and management by a diversity of stakeholders is necessary at different stages over the innovation process in order that smallholder farmers in developing countries develop enough capabilities and consolidate as entrepreneurs. In particular, cases like the Nyabyumba farmers in Uganda and Gataraga farmers in Rwanda show that MSIPs are important incubators of innovation and entrepreneurship.

Given the long-term timeframes required in Sub-Saharan Africa, interventions that intend to make substantial and tangible impacts must be designed to provide proper facilitation and management. Moreover, the timing of an innovation process can be affected by the entrance and exit of development interventions, interrupting or reversing the process of developing and exploiting capabilities. One of the biggest constraints affecting the timing of the innovation process is the shortage of funding for facilitation that limits the design of interventions and the sustainability of the process. Scaling out and up require facilitation to extend the network and continue to develop capabilities, and when resources are available facilitation offers the potential to repeat the cycle of innovation at different organisational levels (Gilsing and Nooteboom, 2006, Van de Ven et al., 2008).

Another constraint mentioned by farmers is about ownership of the innovation process, given that when interventions are designed without the input of the farmers, the sustainability of the process is affected. In this regard, it is important to consider the embeddedness of the innovation process in local governance structures, as observed in the MSIPs. These local governance structures are an entry point for engaging in their innovation process, and are an opportunity to better organise and maintain the sustainability of the innovation process. But facilitation and

management must respond to the local dynamics and demands, according to the capabilities or level of maturity of the innovation network.

Factors that enable the empowerment of farmers as entrepreneurs like good infrastructure, input supply, operational policies, and market opportunities are often decided or influenced at a national or regional level. It follows that the local network and the facilitators of the innovation process need to identify the enabling factors and the actors responsible for making, and furthermore determine how the innovation network can influence decisions. There are still likely to be some missing players whose roles are vital for tackling complex challenges like power and gender imbalances, and other asymmetries, but public and private partnerships like MSIPs are vehicles to engage with these actors.

We conclude that balancing exploration and exploitation with an ambidextrous capacity of innovation networks requires collective roles to orchestrate change and innovation in developing countries.

Chapter 4. **Ambidextrous management of multi-stakeholder cooperatives in sub-Saharan Africa⁵**

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4.1 Introduction

4.1.1 *Producer organizations in developing countries*

Producer organizations in developing countries are a collective mechanism for farmers to pool resources to benefit from economies of scale and deal with challenges such as lack of technology, limited access to markets, lack of credit, poor infrastructure for processing, and asymmetries in value chains (Ton, 2008, Mendoza and Thelen, 2008). There is a broad literature on how producer organizations help smallholder farmers in developing countries to deal with various collective challenges (e.g. Narrod et al., 2009, Bijman, 2007, Vellema and Boselie, 2003, Ton et al., 2007).

However, the dilemma is that most of the benefits provided by producer organizations in developing countries reach only relatively resource-rich farmers (Giel *et al.*, 2007), and there is a majority who could potentially also share in these benefits (Bernard and Spielman, 2009) 82 percent of the African labour force is dedicated to agriculture, an activity that contributes 32 percent of gross domestic product (World Bank, 2006). According to Develtere and Pollet (2008) only 7 percent of the total population of Africa are members of primary cooperatives.

Over the past decade, an increasing number of intervention approaches have emerged that aim to increase the benefits to smallholder farmers from agricultural supply and value chains (Devaux et al., 2007, KIT et al., 2006, Kaaria et al., 2008, Sanginga et al., 2004). In some of these interventions, a diversity of actors collaborate to form multi-stakeholder innovation platforms and public–private partnerships (Horton et al., 2010, Narrod et al., 2009, Vermeulen et al., 2008).

Multi-stakeholder innovation platforms (MSIPs) are presented in this paper as a special type of multi-purpose cooperative that aims to be more inclusive of smallholders. In such cooperatives, different stakeholders facilitate services for fostering collective capabilities through multi-dimensional innovation arrangements, which ultimately aim to improve the entrepreneurial capabilities of members participating in the innovation network, making it become a business network.

How this multi-level setting of stakeholders with multiple social and economic interests is orchestrated, and through which governance mechanisms are gaps in the literature on innovation and management of cooperatives, particularly in complex contexts such as in developing countries. This paper presents different innovation processes via the trajectories of smallholder farmers in different innovation network settings. A longitudinal approach is applied to track the dynamic and multi-level governance mechanisms of innovation networks and the emergence of multi-stakeholder cooperatives.

4.1.2 Theoretical framework

4.1.2.1 Explorative and exploitative dynamics of innovation networks

Cooperatives are “voluntary, democratic and self-controlled business associations” (Wanyama et al., 2009 pg. 362). Producer organizations, as a type of cooperative, have a dual character, serving both social and economic collective purposes, with members who are at the same time both owners and users. This duality leads to ambiguity and many contradictory activities that can make the coordination of cooperatives problematic, particularly when it involves multi-level innovation networks with diverse stakeholders. For instance, how can multi-level stakeholders that have not only different interests, but also sometimes different and competing institutional cultures and professional backgrounds be coordinated? How can members be held accountable as both owners and users of the cooperative? How can the stable participation of members in complying with contract conditions (e.g. production and quality demands) be maintained while the network remains open to having new members in compliance with the principle of open ownership? These are only some of the paradoxes that are difficult to manage and balance in cooperatives.

Managing these activities when tackling challenges in an innovation process calls for a special capability of innovation networks in cooperatives, called ambidexterity, which is a high-level capability for simultaneously managing exploration and exploitation in an innovation process. Innovation networks in cooperatives need to be dynamic in their innovation process given the need

continuously to: i) explore new products, technologies, services or ways of doing things that enhance capabilities (the differentiation stage) (Nooteboom, 2000); ii) exploit these capabilities and obtain tangible benefits (the consolidation stage) (Nooteboom, 2000); and iii) sustain the dynamism of the innovation process. Ambidexterity is a very important capability for the emergence of cooperatives because cooperatives often have to manage contradictory dynamics. Cooperatives have a dual character (Dooren et al., 1982) and need to explore new ways of doing things to accomplish social goals (formation of the capabilities of members), while also exploiting these capabilities for the benefit of their members. Effective balancing of exploration and exploitation in a cooperative, through management design and facilitation of collective action, can result in better capabilities of members of innovation networks to tackle challenges and reach better outcomes. The dynamism of developing capabilities for exploration and exploitation in practice presents many complex challenges. For instance, the preferences of consumers and markets change over time, and this demands new capabilities and the need for coordination of the innovation networks. Consequently, the transition of innovation networks into business networks (exploitation) cannot be left to serendipitous dynamics. There is need for a balance in collective efforts that focus mainly on fostering information, sharing knowledge, learning and exploring capabilities (exploratory networks), while also exploiting capabilities to obtain more formal and tangible benefits (exploitative networks). How this process takes place, how innovation networks organize for collective action and through which governance mechanisms for both exploration and exploitation (structural mobility) is a gap in the literature.

4.1.2.2 Multi-stakeholder innovation platforms: multi-stakeholder and multi-purpose cooperative hubs of innovation and business networks

Innovation and entrepreneurship cannot take place in isolation. Connecting to multi-stakeholder cooperatives with diverse stakeholders is necessary for smallholder farmers tackling various types of societal challenges (poverty, food insecurity, climate change, asymmetries) and enhancing their capabilities as part of innovation networks.

The following section presents some theoretical insights into governance theory, which help analyse how multi-level cooperatives are governed, with their ambidextrous capability of simultaneously exploring and exploiting the capabilities of their members.

4.1.2.3 Inter-organizational relationships and governance mechanisms of innovation networks

Three general coordination mechanisms that apply to innovation networks in producer organizations and multi-stakeholder cooperatives can be identified from various strands of the literature.

The first of these is *mutual adjustment*, characteristic of *peer groups* (Douma and Schreuder, 2008), which is the case of small producer organizations (*small innovation networks*). Indicators of this coordination mechanism are that members have face-to-face communication, belong to the same organizational level, and work together without hierarchy and without higher levels of authority. This type of coordination mechanism is called the *participant governance mode* (Provan and Kenis, 2008). Advantages of this mechanism are that members of the group can better share resources (such as knowledge and information) and manage risks in a collective way, and so can get better benefits from economies of scale and reduced transaction costs compared with the isolated efforts of individuals (such as farmers practising subsistence agriculture). However, from an economic perspective, Douma and Schreuder (2008) underline that the limitation of this coordination mechanism is the risk of shirking by members.

The second coordination mechanism – *simple hierarchy* (Douma and Schreuder, 2008) – has a hierarchy and is the configuration of larger innovation networks of medium-sized firms in which face-to-face communication is not easy. According to Douma and Schreuder (2008), one person can be the intermediary in communication, thereby coordinating the communication of a peer group. The members receive benefits according to their performance, and a manager supervises the group to reduce shirking. This mechanism is similar to what Provan and Kenis (2008) refer to as the *lead governance mode*. When the lead governance is pursued by a third, independent party, Provan and

Kenis define it as a *non-administrative organization* (NAO) governance mode. NAO governance is similar to what Dhanaraj and Parkhe (2006) define as a hub organization, in which a central position in the network structure has prominence and power to perform a leadership role in pulling together the dispersed resources and capabilities of network members. Compared with mutual adjustment governance, inter-organizational relationships in this coordination mechanism are more hierarchical and involve actors who belong to different layers (downstream or upstream, for instance, associated with buyer–supplier relationships or the case of small farmers in contract farming).

Multi-stage hierarchy (Douma and Schreuder, 2008) is the third coordination mechanism and is more characteristic of medium-sized firms that benefit from economies of scale, with hybrid modes of governance. Douma and Schreuder (2008) explain that when a team has a large number of members, it is divided according to different tasks and coordinated by a manager, supervised by a general manager. This hybrid type of governance in a multi-stakeholder cooperative could imply a combination of multiple and sometimes simultaneous inter-organizational relationships, such as the types of interdependency described by Lazzarini et al. (2001) – pooled, reciprocal and sequential.

Governance is an important aspect in cooperatives, because it has to do with how resources are shared in innovation networks, especially knowledge as it is knowledge that is traduced in the exploration and exploitation of capabilities to innovate. Various studies provide insights on governance capability and management design and their importance for the performance of different organizational structures (teams, organizations, networks) that need to balance exploration and exploitation while fostering hybrid capabilities (Cao et al., 2009b, Capaldo, 2007, Chang et al., 2011). This paper studies governance capability in the context of cooperatives.

The research question that will be addressed in this paper is: *How are innovation networks that cooperate with smallholder farmers coordinated to balance exploration and exploitation when tackling collective challenges in an innovation process, and through which governance mechanisms?*

4.2 Methods and Materials

4.2.1 *East African potato netchain case studies: multi-level innovation networks*

We conducted an explorative longitudinal multi-case study to track the coordination mechanisms in emerging multi-stakeholder cooperatives in East Africa. A number of MSIPs have been established to tackle collective challenges by improving the capacity of smallholder farmers to innovate in cooperation with other actors organized in innovation networks. The case study method was selected because is it appropriate for addressing research in which the researcher has little or no control of events (Yin, 2003).

Six producer organizations producing the same commodity (potatoes – *Solanum tuberosum*) and facing similar, usually complex, problems were selected – two each from southwest Uganda, northwest Rwanda and the eastern Democratic Republic of the Congo (DR Congo) (Table 4.1). Three of the producer organizations (one per country) were participating in the Integrated Agricultural Research for Development (IAR4D) project developed by the Sub-Saharan Africa Challenge Programme intervention approach through MSIPs. The other three farmer groups were selected in the agro-ecological zones where the MSIPs are located, in Lake Kivu Pilot Learning Site (Figure 4.1). This sample allowed investigation of different types of coordination mechanism at different scales of innovation network (small, medium-sized and larger agro-enterprises).

Table 4.1. Case study producer organisations

Country	Producer organisations	Location
Uganda	<i>Bufundi United</i> Multi-stakeholder cooperative. Innovation Platform, Integrated Agricultural Research for Development (IAR4D).	Bufundi sub-county Kabale district
	<i>Nyabyumba</i> producer organisation Various interventions, currently contract farming.	Kamuganguzi / Rubaya sub-counties Kabale district
Rwanda	Gataraga Multi-stakeholder cooperative. Innovation Platform. Integrated Agricultural Research for Development (IAR4D). Multi-stakeholder cooperative.	Gataraga secteur Musanze district Nord Province
	<i>Abahujumugambi</i> producer organisation. 3G Potato project by International Potato Center (CIP).	Nyange secteur Musanze district Nord Province
DR Congo	<i>Muungano Multi-stakeholder cooperative</i> . Integrated Agricultural Research for Development (IAR4D).	Kisigari groupement Rutshuru territoire North Kivu province
	<i>Gamaru</i> farmers' group. Subsistence agriculture. Small farmer group.	Rugari groupement Rutshuru territoire North Kivu province

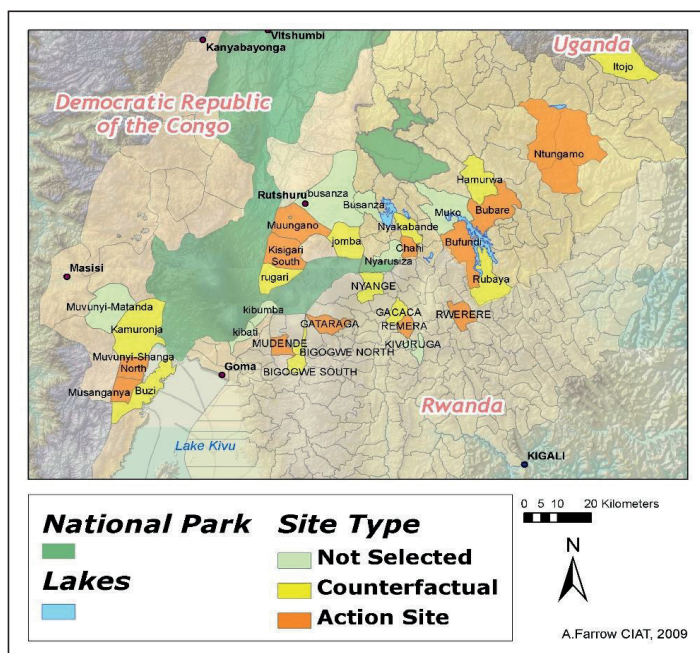


Figure 4.1. Location of Lake Kivu Pilot Learning Site (LKPLS)

4.2.2 Tracking governance dynamics of innovation networks over time

Data collection was divided in two phases in order to capture changes of coordination mechanisms over time. Semi-structured interviews, observations and focus groups were conducted with key informants represented by members of producer organisations and other -stakeholders (Table 4.2). Retrospective questions related to ‘challenges of innovation’ or problems they faced using the event mapping schema of Van de Ven et al. (2008), the *participatory mapping of the evolution of innovation networks* for tracking governance dynamics (Pérez Perdomo, 2011), and tracking the services offered in the innovation network to tackle collective challenges in a particular context (organisational, institutional, financial, etc.). Informants were also asked questions about the general innovation challenges and contextual conditions for drawing the “environment” for innovation. The netchain analysis of Lazzarini et al. (2001) was adjusted to track and analyse the inter-organizational relationships and coordination mechanisms of innovation networks with a multi-layered and relational approach. The configurations of netchains at the stages when they face certain innovation challenges were drawn to show the multi-layered configuration of innovation networks and their structural dynamics.

The classifications of reciprocal, sequential and pooled interdependencies (Lazzarini et al., 2001) were used as indicators of predominant governance mechanisms. The pooled (---) and reciprocal (\leftrightarrow) interdependencies among peers – which have to do with horizontal ways of integration (Ruben et al., 2006) – were then tracked and mutually adjusted, reflecting whether they are sustained informally or more formally. Adjusted Lazzarini et al. (2001) sequential interdependencies (\downarrow) were used to track the organizational relationships that are established between two types of stakeholder member of a cooperative and that are directly related in an activity that is sequential (i.e. vertical integration) (Ruben et al., 2006). In this type of simple hierarchy coordination mechanism, it is expected that interdependencies among members of a cooperative are formally established, for instance, through contracts.

Table 4.2. Producer organisation and stakeholders at multi-level layers of the netchain

Processor/retailer	Virtual level –ICT mediated	1 MSIP Forum IP Presidents IP Secretaries IP M&E Facilitators
Transporter wholesaler	Geographical and institutional level	2 Farmers 3 Farmer association President association Secretary association
Regional Cooperative	Multi-stakeholder level	4 Local NGO Manager NGO Diobass Farmer advocacy groups Sydip (Farmers' union)
Farmer cooperative	Organisational level	5 Extension agents Governmental Imbanga Farmer Federation
Farmers	Team level	6 Task force leaders Pilot learning site coordinators
Inputs	Family level	7 National data managers M&E regional data manager IP National Coordinators
		8 Researchers IP National Coordinators Rwanda Agricultural Board (previously ISAR) INERA Observatoire Goma Makerere University Rwanda National University
		9 Seed processor
		10 Service provider Traders Transporters Facilitator road construction project
		11 Finance MECREGO
		12 Distributor JORO Kampala Potato Traders Association
		13 Retail/food outlet/processor Nandos Nakumati supermarket Pronapika (Food processor)
		14 Policy maker

Key informants – (potato enterprise)
1 task force leader/researcher/manager (Makerere University), 1 researcher (Open Distance Learning Network)
1 researcher (National Agricultural Research Organisation-NARO), 1 policy-maker (Kabale district), 1 national data manager (Makerere University), 1 processor/retailer (Huntex), 1 seed processor, IP national coordinator
IP president, IP secretary, 3 farmers, 1 trader, 2011 focus group with farmer group
Cooperative president, cooperative secretary, 10 farmers, 1 researcher (International Center for Tropical Agriculture-CIAT and National Agricultural Research Organisation-NARO), 2011 focus group with farmer group
1 task force leader/researcher/manager (Rwanda Agricultural Research Institute-ISAR), IP national coordinator, 1 farmer association extension agent in value addition (Rwanda Farmers Federation), 1 national data manager (ISAR), 1 university researcher (National University of Rwanda), 1 M&E manager (Forum for Agricultural Research in Africa-FARA and ISAR)
1 supermarket retailer
1 facilitator-researcher (International Potato Center-CIP), 1 extension worker, 10 farmers, 2011 focus group with farmer group
1 credit provider (Mutuelles d'Épargne et de Crédit de Goma-MECREGO), 1 farmer association extension agent (Syndicat de Défense des Intérêts Paysans-SYDIP), 1 research extension agent (CIAT-Tropical Soil Biology and Fertility-TSBF institute, 1 NGO manager (Diobass), IP national coordinator (National Institute for Research and Agricultural Studies-INERA), 1 researcher (Goma Vulcanological Observatory), 1 processor, 1 national data manager (Diobass)
6 farmers
2011 focus group with farmer group

4.3 Results

The governance mechanisms that applied in the six producer organizations differed and influenced the types of outcome (Table 4.3 and Table 4.4).

Multi-stakeholder innovation cooperatives progressively enhanced the exploration and exploitation capabilities of smallholder farmers in innovating, reacting and adapting to multi-dimensional challenges in cooperation with multi-level stakeholders in the potato netchain (Table 4.4). Various services were facilitated for enhancing the various capabilities of members.

4.3.1 Multi-stakeholder cooperatives and their ambidextrous management of innovation networks: a typology of coordination mechanisms

The changes in organizational relationships (informal and formal contractual relationships, exploratory and exploitative alliances) among stakeholders were used as indicators of coordination mechanisms. As new challenges emerged, the configurations of actors and their organizational relationships (ORs) changed.

The dynamics of innovation networks were observed to be affected positively and/or negatively by the institutional landscape, as explained in the following.

4.3.1.1 Mutual adjustment governance of innovation networks of small producer organizations

Mutual adjustment–first order governance (small innovation network) was identified as a type of coordination mechanism for innovation networks when face-to-face communication is needed for actors to explore and exploit innovations. Inter-organizational relationships in this coordination mechanism are based on mutual interdependency.

Table 4.3 Challenges and opportunities faced by producer organizations

Producer organization	Country and district	Challenges faced by small farmers in the potato enterprise before 2010	Opportunities
<i>Bufundi United</i> multi-stakeholder cooperative: innovation platform, IAR4D	Uganda Kabale district	<ul style="list-style-type: none"> • Competing land-use claims • Poor farmer organization • Scattered marketing • Limited access to technologies (clean seeds and agricultural inputs) • Soil infertility and erosion • Limited knowledge of natural resource and crop management • Production of potatoes of poor quality because of diseases (such as bacterial wilt) • Poor financial capacity of farmers to obtain credit (lack of collateral) and repay loans • Corruption, governance problems • Lack of operational policies • Lack of information on markets and prices. • Poor bargaining power • Poor linkages to other actors in the potato netchain • Poor road infrastructure roads, high transport costs 	<ul style="list-style-type: none"> • East African Community Common Market • Written policies • Microfinance facilities such as savings and credit cooperatives • Connectivity of farmers using mobile phones
<i>Nyabyumba</i> farmer cooperative: various interventions, currently contract farming			
<i>Gataraga</i> multi-stakeholder cooperative: innovation platform, IAR4D	Rwanda Musanze district, Nord Province	<ul style="list-style-type: none"> • Competing land-use claims. • Small plots for producing potatoes • Production of potatoes of poor quality because of diseases (such as bacterial wilt) • Limited financial capacity of farmers to obtain and repay credit • Limited knowledge of natural resource and crop management • Little information on markets and prices. Imbalance in bargaining power • Poor linkages to other actors in the potato netchain 	<ul style="list-style-type: none"> • Organized farmers • Increasing financial opportunities • Access to technologies (clean seeds and agricultural inputs) coordinated through farmer groups (such as Rwanda Farmers Federation) • East African Community Common Market • Written policies and more operational policies (compared with Uganda) • Government fighting corruption • Good infrastructure, no high transport costs • Connectivity of farmers using mobile phones
<i>Abahujumugambi</i> farmer cooperative: 3G potato project of CIP			
<i>Muungano</i> multi-stakeholder cooperative: IAR4D	DR Congo Rutshuru district, North Kivu Province	<ul style="list-style-type: none"> • Very poor farmers • Civil war, impossibility of farmers being organized • High migratory movements • Untrusting environment • Competing land-use claims • Erosion • No access to technologies (clean seeds and agricultural inputs) • Limited knowledge of natural resource and crop management. • Production of potatoes of very poor quality because of diseases (such as bacterial wilt). Market intermediaries use the bad reputation of potatoes in this area to reduce the bargaining power of farmers • Scattered marketing • Lack of information on markets and prices. No access to ICTs such as mobile phones. No bargaining power • No financial options and lack of financial capacity of farmers to obtain credit (lack of collateral) and repay loans • Corruption, governance problems • No written policies <p>Very bad road infrastructure, very high transport costs that often leave farmers without profits</p>	<ul style="list-style-type: none"> • High prices of potatoes in Kinshasa, where potatoes are considered a luxury. Processors interested in buying potatoes from small farmers to reach this market opportunity. Value addition is needed: technology for drying potatoes to be transported to Kinshasa by air because there are no roads • East African Community Common Market
<i>Gamaru</i> farmer group: subsistence agriculture, small farmer group			

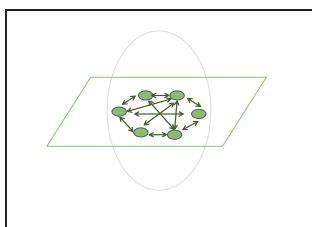
Source: Data from interviews.

Table 4.4 Services facilitated for producer organizations, and their outcomes (2010-2011)

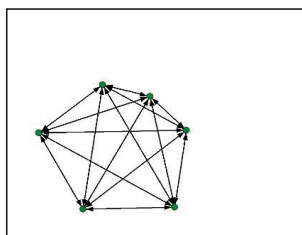
Producer organization	Country and district	Services facilitated to tackle challenges and foster the exploration and exploitation of capabilities			Outcomes – consolidation of capabilities (exploitation)	Estimated size of innovation network and linkages	
		Organizational	Technological-technical	Knowledge		Before 2010	2010–2011
<i>Bufindi United</i> multi-stakeholder cooperative: innovation platform, IAR4D	Uganda Kabale district	MSIP V, DAP, M&E, CP, CM Sanctions and reward system	Technological innovations: production, NRM, strategies for controlling erosion, post-harvest management, making of by-laws on land use with local government, exploring value-addition opportunities	Knowledge sharing and information management, use of ICTs	Opening of MSIP bank account, financial, making of by-laws on land use with local government, linkages to markets	Farmers not organized as a producer organization	152 members organized as a producer organization with linkages to various clusters in the potato network
<i>Nyabumba</i> producer organization: various interventions, currently contract farming		V, CP, CM	Technological innovations: production, NRM strategies, post-harvest management, value addition	Knowledge sharing and information management, use of ICTs	Contracts with restaurants in Kampala, collaborative innovation arrangements with transporters	Farmers participated in an MSIP and formed a producer organization with multiple linkages to other clusters in the potato network	120 members doing contract farming, limited linkages to clusters in the potato network
<i>Gataraga</i> multi-stakeholder cooperative: innovation platform, IAR4D	Rwanda Musanze district	MSIP V, DAP, M&E, CP, CM Sanctions and reward system	Technological innovations: ISAR provided clean seeds (Victoria), positive- negative potato seed selection, NRM strategies, post-harvest management, value addition: packaging using local materials	Knowledge sharing and information management, use of ICTs, value addition: packaging using local materials, social positive selection to select representatives for different activities	Credit from financial institution, contracts with Nakumati supermarket and some hotels	Farmers linked to Rwanda Farmers Federation	200 members organized as a producer organization to sell potatoes in Kigali, linkages to various clusters in the potato network
<i>Abahungambizi</i> producer organization: 3G potato project of CIP		Formation of community of practice for learning by doing	Diffusion of positive selection (exploitation), no exploration of opportunities for innovation	Formation of community of practice for learning by doing	Selling of clean potato seeds to other farmers	Farmers linked to Rwanda Farmers Federation	40 members of Rwanda Farmers Federation, very limited linkages to other clusters in the potato network
<i>Muungano</i> multi-stakeholder cooperative: IAR4D	DR Congo Ruushuru district, North Kivu Province	MSIP V, DAP, M&E Sanctions and reward system	Technological innovations: clean seeds: INERA provided seeds (Cahinga, Kinigi and Victoria), production and NRM strategies, post-harvest management, value-addition technologies	Knowledge sharing and information management	No formal outcome: process affected by civil war	Most farmers belonged to religious community, which facilitated education for children and other community activities, giving support, especially after civil war	450 members of producer organizations (in different villages) with linkages to various clusters in the potato network
<i>Gamaru</i> producer organization		Farmers in small groups (with family or friends)	Lack of technology, especially clean seeds	Knowledge sharing in communities of practice	No formal outcome: process affected by civil war	Producer organization organized with linkages to extension agents, but when civil war broke out, farmers were isolated	80 members of producer organizations with very limited linkages to other clusters in the potato network

CM = organization of farmers for collective marketing; CP = organization of farmers for collective production; DAP = designing action plans; ER = exploration of innovations; ET = exploitation of innovations; M&E = monitoring, evaluation and reframing of action plans; PPP = public-private partnership; Pr = private; Pub = public; V = visioning and exploring opportunities for innovation.

Small innovation networks (Figure 4.2a) were formed with few members and no hierarchy (Douma and Schreuder, 2008). Members of this type of coordination mechanism sustain reciprocal interdependencies (\leftrightarrow) when the innovation network requires stability for exploiting innovations and also when exploring new ways of doing things, as when farmers needed to participate in communities of practice to learn new techniques (Figure 4.2b). In addition, producer organizations needed to be more organized as groups to be able to carry out collective production and marketing, so a stable innovation network was necessary.



(a) Mutual adjustment governance of innovation networks in small producer organisations.



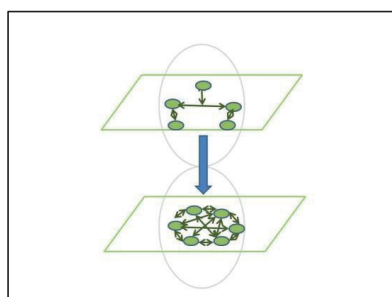
(b) Reciprocal (\leftrightarrow) interdependencies. E.g. Necessary for farmers to comply with quantity and quality demands.

Figure 4.2. Examples of mutual adjustment

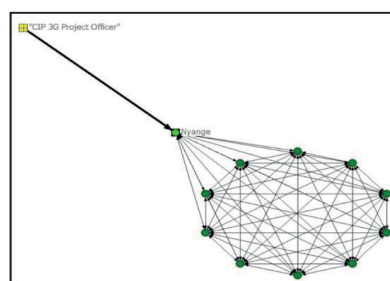
4.3.1.2 Hierarchical governance of innovation networks in larger producer organizations:

Hierarchical-second order governance (larger innovation networks) was the type of coordination mechanism identified in larger innovation networks. Inter-organizational relationships are more hierarchical and established among actors that belong to different layers (upstream or downstream) of the netchain (Figure 4.3). This type of inter-organizational relationship is characteristic of the vertical integration between two different clusters of stakeholders, sustaining sequential interdependencies (\downarrow) with other stakeholders with whom they are directly interdependent in an activity that is sequential (Figure 4.3a), such as in the type of inter-organizational relationships sustained among producer organizations and extension agents and commonly used for the diffusion and adoption of technologies or knowledge transfer through linear approaches. Specific examples include the type of interdependency between

farmers in the multi-stakeholder cooperative in Gataraga and the supermarket buyer of potatoes in Kigali, and the linear diffusion of technologies by producer organizations in Nyange, Rwanda (Figure 4.3b). There are formal transactions among stakeholders belonging to two different layers of the netchain (signing of contracts in contract farming or economic transactions, knowledge transfer transactions, etc.). The focus was on tackling the innovation challenge of the lack of clean seeds, with farmers fostering their capabilities in NRM. However, there were no other complementary capabilities facilitated in the innovation network (marketing and forming linkages to markets, financial capabilities and the facilitation of credit, cooperation, knowledge sharing with other actors in the potato value chain, etc.) compared with the farmers who participated in the multi-stakeholder cooperative in Gataraga. Participative decision-making or negotiation was also lacking.



(a) *Hierarchical and mutual adjustment* governances. Sequential (\downarrow) and reciprocal (\leftrightarrow) interdependencies



(b) Abahujumugambi farmers' group, CIP 3G potato project (2010), Rwanda. Farmers are led by CIP on the diffusion of the positive selection technology for tackling the challenge of lack of clean seeds.

Figure 4.3. Examples of hierarchical governance

The innovation network structures of farmers working with hierarchical ways of coordination were relatively static and maintained the same types of sequential interdependency along the trajectory, as in the case of Abahujumugambi producer organization. Farmers worked with the extension worker to translate an innovation into a concrete outcome (adoption of the positive selection technology) to tackle the challenge of the lack of clean seeds. Farmers were restricted to acting as passive agents and were limited to farming activities. However, these traditional

agriculture and rural development intervention approaches were seen by farmers as very important for the facilitation of technology transfer and were a step towards participating in more complex innovations.

Similarly, in Uganda, the Nyabyumba producer organization had a hierarchical coordination mechanism formalized in a contractual relationship (business-oriented contract farming). However, when this coordination mechanism was consolidated for a period of more than eight years, a stagnant period for innovation started and limitations emerged. Along their innovation trajectory, farmers developed their knowledge, production, technological capabilities (e.g. clean seeds), NRM and entrepreneurial capabilities. However, at a certain stage of their trajectory no new linkages to markets or new value-addition possibilities emerged, as these were limited by the lack of resources, especially land and financial capability for obtaining more credit.

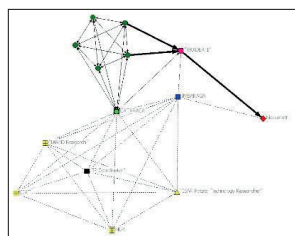
4.3.1.3 Dynamic meta-governance of multi-stakeholder cooperatives – ambidextrous management of multi-level innovation networks

The same coordination mechanisms applied in the three sites where small farmers participated in the IAR4D approach, with the facilitation of various stakeholders to foster capabilities of farmers in MSIPs.

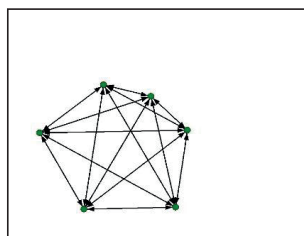
Meta-governance (hybrid governance) of innovation networks is the type of coordination mechanism that was identified in these MSIPs. Dynamic and hybrid coordination mechanisms emerged over time, balancing the dynamics of exploration and exploitation for a more sustained performance. Each MSIP is a *mobile hub(s) of innovation networks* involving various clusters of stakeholders at different levels and over the innovation process, who collaborate in the formation of different innovation arrangements.

When comparing the structural changes in the innovation networks of the cases studied, it was observed that innovation networks stabilize and disband over time as, responding to the innovation challenges, actors organize through different governance coordination mechanisms, As new challenges emerged, the configurations of actors participating in innovation networks of

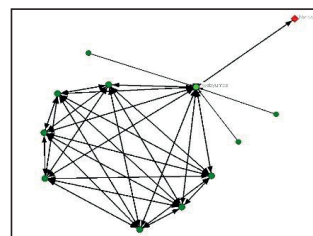
the potato netchain changed, with innovation networks closing when there was a need of stability for exploiting innovations, and opening again for exploring new ways of doing things.



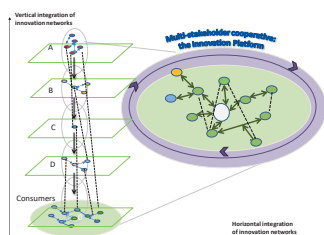
(a) 2008 Complex multi-level innovation network to tackle collectively the challenges. This is the case of the multi-stakeholder platforms, combining multi-level and hybrid governance (Figure 4.4d)



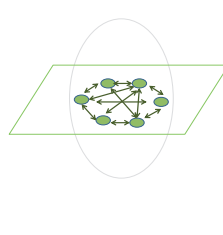
(b) 2009 Stable innovation network to comply with production and marketing challenges. E.g. small producer organisations working in a community of practice (Figure 4.4e)



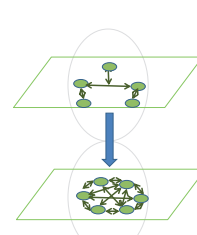
(c) 2010 Hierarchical innovation network, with an organisation leading the innovation network. E.g. for collective marketing of potatoes for contract farming between Nakumati supermarket and farmers in Gataraga (Figure 4.4f)



(d) Meta-governance. Pooled (---), sequential (↓) and reciprocal (↔) interdependencies



(e) Mutual adjustment governance. Reciprocal (↔) interdependencies



(f) Hierarchical and mutual adjustment governance. Sequential (↓) and reciprocal (↔) interdependencies

Figure 4.4. Netchain analysis for tracking governance dynamics of innovation networks in an IP (multi-stakeholder cooperative). Netchain analysis of the Gataraga farmers' producer organisation and the Innovation Platform in Rwanda, IAR4D approach.

Inter-organizational relationships also changed over time. The multi-stakeholder cooperatives also facilitated linkages among farmers and a diversity of stakeholders (Figure 4.4, Figure 4.5 and Table 4.5). Loose types of inter-organizational relationship were facilitated for the exploration of innovation opportunities and for reciprocal and sequential inter-organizational relationships. (e.g. Figure 4.4c). Changes in partnerships over time were also observed (Table 4.5).

Table 4.5 Comparison of partnerships in case study producer organizations

Producer organization	Types of partnership (2009) and actors in innovation networks	Types of partnerships (2011–2012) and actors in innovation networks
<i>Bufundi United</i> multi-stakeholder cooperative: innovation platform, IAR4D	Public partnerships: Africa 2000 Network (A2N), NARO, CIAT	Public and private partnerships facilitated in the MSIP: FARA, Makerere University, NARO, CIAT, local government, A2N, Huntex Industries, Mutuelles d'Épargne et de Crédit de Goma-MECREGO
<i>Nyabyumba</i> producer organization: various interventions, currently doing contract farming	Public and private partnerships facilitated in the MSIP: Africa 2000 Network (A2N), NARO, CIAT, Nandos	Private partnership: contract with Nandos, Tropical Heat (food outlet)
<i>Gataraga</i> multi-stakeholder cooperative: innovation platform, IAR4D	Public partnerships: Rwanda Farmers Federation, ISAR	Public and private partnerships facilitated in the MSIP: FARA/ISAR, ISAR, Rwanda Farmers Federation, National University of Rwanda, CIAT, MECREGO, Nakumati supermarket, Ninzi hotel
<i>Abahujumugambi</i> producer organization: 3G potato project of CIP	Public partnerships: Rwanda Farmers Federation, ISAR	Public partnerships: 3G potato project, Rwanda Farmers Federation
<i>Muungano</i> Multi-stakeholder cooperative: IAR4D	No formal partnerships	Public and private partnerships facilitated in the MSIP: Diobass, INERA, (Goma Vulcanological Observatory), SYDIP, processor, Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA), MECREGO
<i>Gamaru</i> producer organization	No formal partnerships	No formal partnerships, no intervention approaches

Producer organizations participating using the IAR4D approach with the MSIP as a core component had a comparative advantage over the other producer organizations (Table 4.4). Facilitation to foster multiple capabilities was provided by a diversity of stakeholders playing various roles (Pérez Perdomo et al., 2016). In the MSIPs, not only capabilities for producing clean seeds were fostered – through the diffusion of technologies to tackle the problems of bacterial wilt – but also the organizational capability of farmers to market and produce potatoes collectively. The MSIPs also fostered knowledge and learning capabilities, the formation of communities of practice (horizontal integration), and the availability of a variety of information

and knowledge sharing mechanisms, including the use of ICTs to reduce information asymmetries of farmers and reduce the opportunistic behaviour of traders. In the MSIPs, farmers were taught how to weigh produce in kilograms to avoid being cheated by traders. Other knowledge capabilities were fostered through teaching of techniques for more sustainable NRM. Organizational capabilities were improved through making linkages between farmers and financial institutions to provide loans without requiring collateral, allowing farmers to buy seeds and other market inputs. Entrepreneurship was fostered through making business linkages between farmers and buyers (hotels, supermarkets, etc.) and formalizing supply chain relationships through contracts (vertical integration). An example of institutional arrangements is the making of by-laws and the creation of systems of rewards and sanctions to avoid free-riding behaviour. This combination of services and facilitation allowed farmers to develop their capabilities to explore and exploit opportunities for tackling their challenges more effectively and sustainably by being empowered to do things on their own (Table 4.4).

4.3.2 Context-sensitiveness of innovation: enablers and barriers

It was clear that the institutional landscape exerted a big influence on the trajectories of the innovation process of producer organizations, presenting challenges and opportunities for innovation (Table 4.3). In Rwanda, the innovation trajectories benefited in general terms from a better institutional landscape including services for enhancing the organizational capacity of farmers (e.g. via the Rwanda Farmers Federation), better road infrastructure, more operational policies, and more support from the government for the development of cooperatives, such as through the cooperative legal and statutory framework of 2006 (MINICOM, 2006). This supportive framework enhanced the organizational capacity of farmers for collective action and the making of formal agreements such as contracts, as in the multi-stakeholder cooperative in Gataraga. However, a negative factor that hinders innovation efforts of producer organizations in Rwanda is land scarcity (Jayne et al., 2010), and land use is highly regulated by government.

Through the influence of the institutional landscape and its multi-dimensional boundaries, some trajectories of innovation networks were erratic, such as the case of the producer organization in the MSIP in Bufundi (Uganda), where power dynamics affected the innovation process. In this case, competing coordination mechanisms of innovation networks were observed, with local governance competing against the self- and temporal coordination mechanism of the innovation networks in the multi-stakeholder cooperative. Despite the fact that negotiation was mediated in the multi-stakeholder cooperative through the making of by-laws with the support of the local government, this negotiation was insufficient. According to farmers, there were hidden local agendas so the inclusion of higher levels of government would have been more effective for the negotiation process.

In contrast, and in an extreme position in relation to the other cases, the members of Gamaru farmer union in DR Congo were limited to subsistence agriculture. They had been part of a producer organization but because of civil war they were no longer working collectively. Farmers produced potatoes for their home consumption, as long as thieves or displaced people in the area did not steal their produce. When the civil war ceased, farmers tried to reorganize their farmer producer organization, but this was difficult because members were dispersed. Farmers could not deal with the challenges in Rutshuru district, such as the dynamics of local markets, the bad reputation of local potatoes because of their low quality (lack of water in the area), scattered production resulting in little bargaining power, and high transport costs in relation to the serious economic limitations of the producers. This situation favoured the opportunistic behaviour of some traders who came to Rutshuru and took advantage of the market information asymmetry of farmers, reducing their bargaining power. In addition, given the bad state of roads and the high costs of transport, farmers did not have the possibility of exploring new markets. Nearby, Muungano producer organization was also highly affected by the contextual dynamics in Rutshuru. The governance of the MSIP fostered the organizational capacity of farmers and

linkages to other stakeholders (e.g. a credit institution and a processor), greater trust, access to multiple sources of knowledge, access to various resources such as information and agricultural technologies, access to financial support, and improvement of entrepreneurial capabilities to consolidate as business networks for the collective production and marketing of potatoes. The MSIP was a mobile hub for value addition. However, the outcomes for this producer organization were not good, and when the civil war started again, farmers were displaced. In November 2013, some farmers from Rutshuru were still refugees in Uganda, while others were returning.

4.4 Discussion

This section analyses and relates the three main principles of cooperatives to the principles of MSIPs.

4.4.1 *User-owned multi-stakeholder cooperatives*

This is the case of MSIPs, which are spaces for cooperation and co-innovation. They are organizations that share a *concern for the community*, which is a principle of cooperatives.

An MSIP is a multi-purpose cooperative. Different activities are organized in this multi-stakeholder cooperative with the participation of diverse stakeholders going further than the arrangements of traditional linear approaches that focus mainly on the diffusion and adoption of technologies by farmers. A MSIP is a special multi-stakeholder cooperative that fosters various capabilities (organizational, technological, knowledge, institutional). Members, mainly farmers, are not restricted to farming and participate in all activities, including decision-making regarding what, by whom, when, why and with whom activities are carried out. In a multi-stakeholder cooperative, farmers are no longer recipients of technologies. Instead they are active agents of the innovation process, being part of a more complex configuration of innovation networks that includes other stakeholders such as seed producers, traders, extension agents, researchers, transporters, processors and delegates from local government. Farmers participate in the vertical,

horizontal and cross-integration of innovation networks, not only in innovations related to chain activities in production and post-harvest activities (e.g. land preparation, weeding, harvesting, storing), but also in innovations related to netchain governance (decision-making processes, information, quality, marketing, cooperation and innovation management) for horizontal integration (Figure 4.5 and Figure 4.6).

4.4.2 User controlled multi-stakeholder cooperative

A cooperative follows the principles of: i) democratic control by members; ii) autonomy and independence; and iii) concern for the community (International Co-operative Alliance, 2015). Membership of a multi-stakeholder cooperative is also voluntary and open, with democratic control by members (one member, one vote). Decision-making is democratic, and in this way, members control their cooperative. Solutions cannot be imposed by external actors but have to be negotiated. Action plans are the mechanisms that define the progress of collective action, and are adjusted when needed.

A multi-stakeholder cooperative is a multi-purpose type of cooperative that has a dynamic meta-governance to manage multi-level innovation networks. Its ambidextrous management is a hybrid of formal management structures and emergent mobile hubs or fora that involve stakeholders of different levels of the network (the local, national, regional and ICT-mediated levels) (Figure 4.5). The multi-stakeholder cooperative does not govern the networks from a central, neutral position. 'Mobile hubs of innovation networks' emerge and change their composition over the innovation process (Figure 4.5). The mobile hubs orchestrate the innovation network at different levels (network levels or for different clusters or layers of the netchain), changing their locus and stakeholder depending on the nature and complexity of the challenges (Figure 4.6 and Figure 4.7). At the local-farmer level, the management structure is based on the community governance structure that is locally embedded (Figure 4.5 and Figure 4.6). The basic management structure at this local level is composed of a president, a vice

president, a secretary and the representatives of different committees (finance, monitoring and evaluation, productivity) (Figure 4.5). At the national level there is a leading organization (in Uganda an entrepreneurial university, in Rwanda a research organization and in DR Congo an NGO), and at the regional level, there are task force managers (focussed on the interfaces among productivity, natural resource management and markets). The cooperative fosters horizontal, vertical and cross integration among members, facilitating reciprocal, sequential and pooled organisational relationships among members, and a combination of public and private partnerships. Stakeholders participate in decision-making on what activities are carried out, by whom, when, why and with whom. The MSIP, multi-stakeholder cooperative facilitates more transparency in processes because all activities are monitored by its members, which include diverse stakeholders and actors of the civil society.

The mobile hubs of innovation networks (Figure 4.5, Figure 4.6 and Figure 4.7) emerge and manage interfaces in the innovation process (natural resource management, technology management, network management, etc.), fostering the coordination and cooperation at the local, national, regional and international levels (*principle of cooperation among cooperatives*).

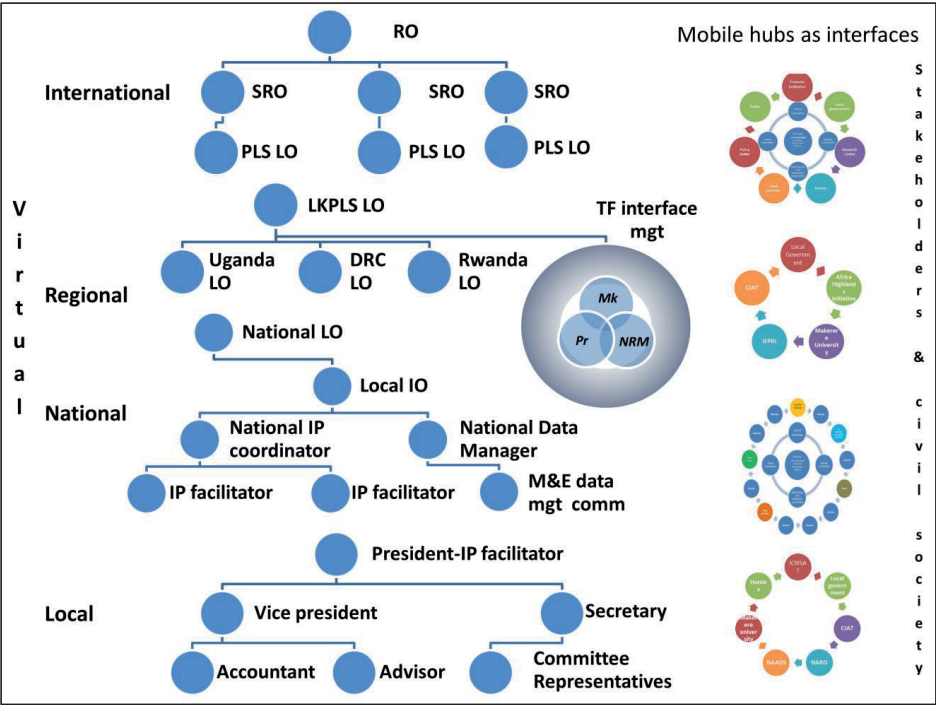


Figure 4.5 Management structure of multi-stakeholder cooperatives and mobile hubs of innovation networks

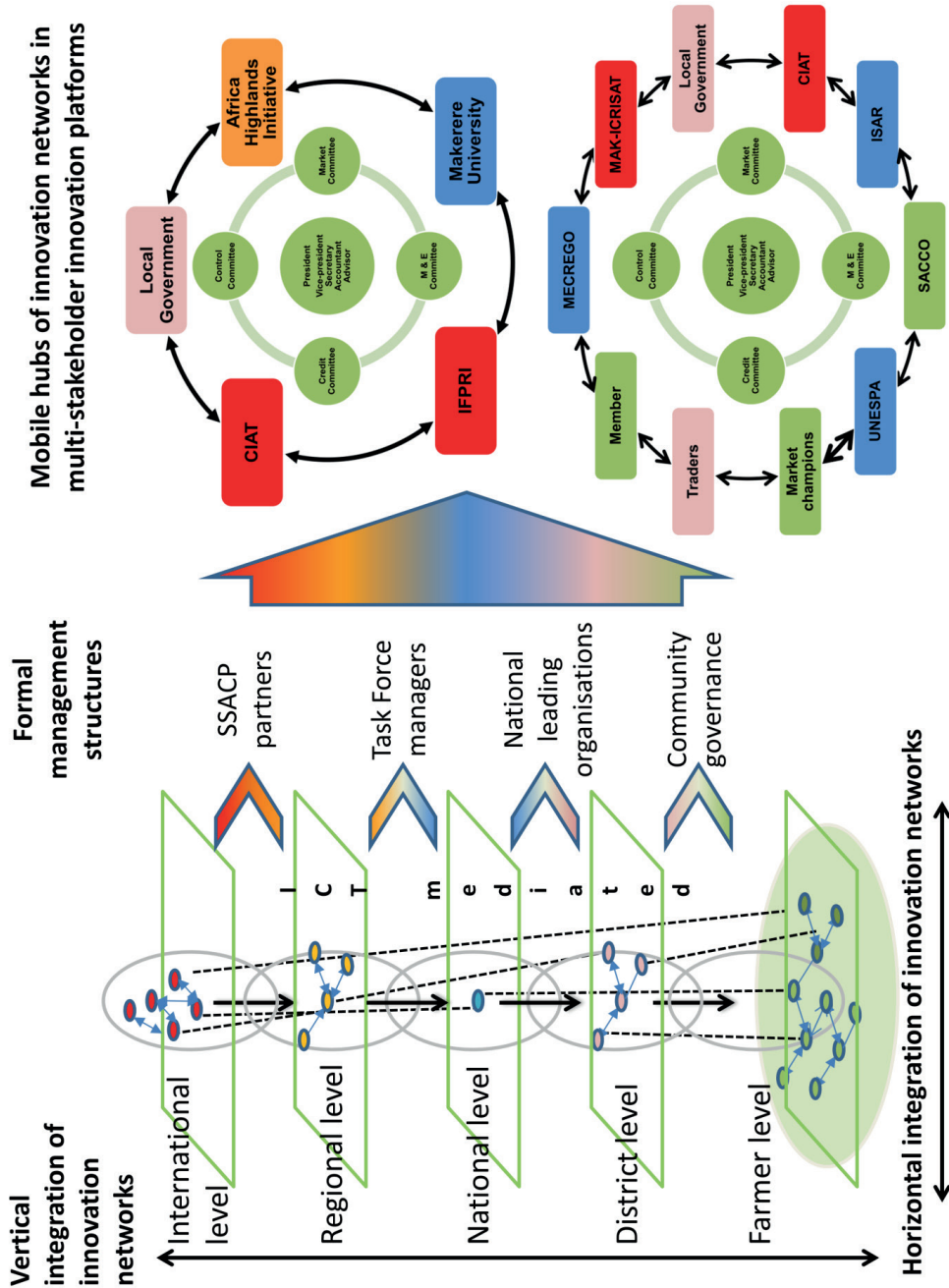


Figure 4.6 The multi-stakeholder cooperative is governed by an orchestrated management structure and emergent mobile hubs of innovation networks.

Aug-Dec.2009.Challenge: low bargaining power in potato marketing	Aug-Dec.2009.Challenge: Profitability
Aug-Dec.2009. Challenge: Post-harvest handling	Aug-2009 continuous. Challenge: Policy issues (e.g. by-laws, mediation conflicts pastoralists and potato growers).

Figure 4.7 Mobile hubs of innovation networks in Bufundi, Uganda (Open for-a-innovation platform). The configuration of organisation of the mobile hub changes over time according to challenges (Source: Pérez Perdomo (2011) and FARA (2007)).

4.4.3 User benefits of multi-stakeholder cooperatives

An MSIP is a multi-purpose cooperative because its members have access to various resources and services of the cooperative (the user benefit principle). Members develop their capabilities to be empowered, for instance, by conducting M&E tracking of the innovation process. Farmer members of the cooperative also share various resources to foster capabilities (exploration) and participate in the consolidation of outcomes of the process (exploitation) – *economic participation*. One of the most important benefits for the members of a multi-stakeholder cooperative is the possibility for knowledge sharing in communities of practice at different levels (supply, value and netchain), so the principle of *education, training and information* is followed. This principle provides farmers with access to a variety of knowledge and expertise from different stakeholders on NRM, pre- and post-harvest management of potatoes, collective marketing, value addition, etc.

4.5 Conclusions

Innovation and entrepreneurship are not possible without cooperation, which emphasizes the importance of the social organization of innovation networks through different governance mechanisms. Empirical evidence has shown that there are three governance mechanisms of these innovation networks: i) mutual adjustment governance of small innovation networks; ii) hierarchical governance of larger innovation networks; and iii) dynamic meta-governance in multi-stakeholder cooperatives. These coordination mechanisms change according to the innovation challenges that farmers (and other stakeholders) face. As a result, innovation networks stabilize and disband over time (opening and closing), following self-organized coordination mechanisms (Pyka and Küppers, 2002). In this study, structural dynamics were used as indicators of the governance mechanism. Changes in governance mechanisms depend on: i) the types of challenge; ii) the size and diversity of the innovation network; iii) the interest of stakeholders; iv) linkages among stakeholders; v) the timing of innovations; vi) the contextual dynamics of innovations; and vii) risks.

An example of this governance mechanism occurred when farmers were organized with other peers in their village and through a stable innovation network; they could explore innovations and learn from each other through communities of practice. This horizontal integration of networks, or bonding, is crucial for farmers in improving their capacity for collective production and marketing of potatoes, and being organized to comply with quality and quantity standards. Reciprocal inter-organizational relationships are then sustained among members of the innovation network. However, the limitation of this coordination mechanism is that the size of the innovation network can limit the innovation capacity of farmers, such as complying with quantity requirements when doing contract farming.

For the coordination of larger innovation networks, when face-to-face communication is not easy among members, a hierarchical governance is needed for the vertical integration of the network, to bridge different stakeholders (such as in the formation of a supply chain). Through this coordination mechanism interdependent clusters of the potato netchain were connected, such as farmers to traders, transporters and innovation intermediaries, sustaining sequential interdependencies. Eventually, this type of coordination mechanism resulted in the exploitation of capabilities of the innovation network, as in the case in Rwanda, when farmers signed contracts with supermarkets and hotels in Kigali, or in the case of contract farming in the Nyabyumba group in Uganda, where farmers consolidated their enterprise. However, the limitation of this coordination mechanism is that too much linearity in some cases can hinder the exploration of new ways of doing things, such as when the network is closed and does not allow the entrance of new members and new sources of knowledge.

Multi-stakeholder cooperatives and their hybrid and dynamic governances foster horizontal, vertical and cross-integration of innovation networks and a combination of capabilities for exploration and exploitation (Figure 4.8 and Figure 4.9), by having the facilitation of stakeholders at different levels.

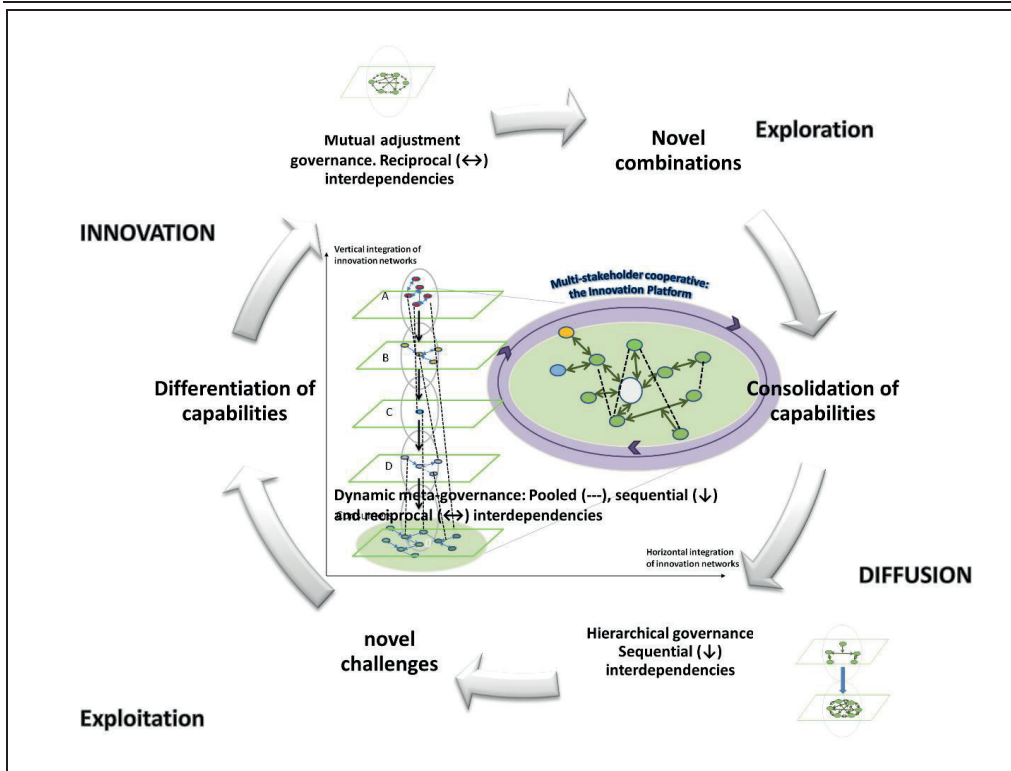
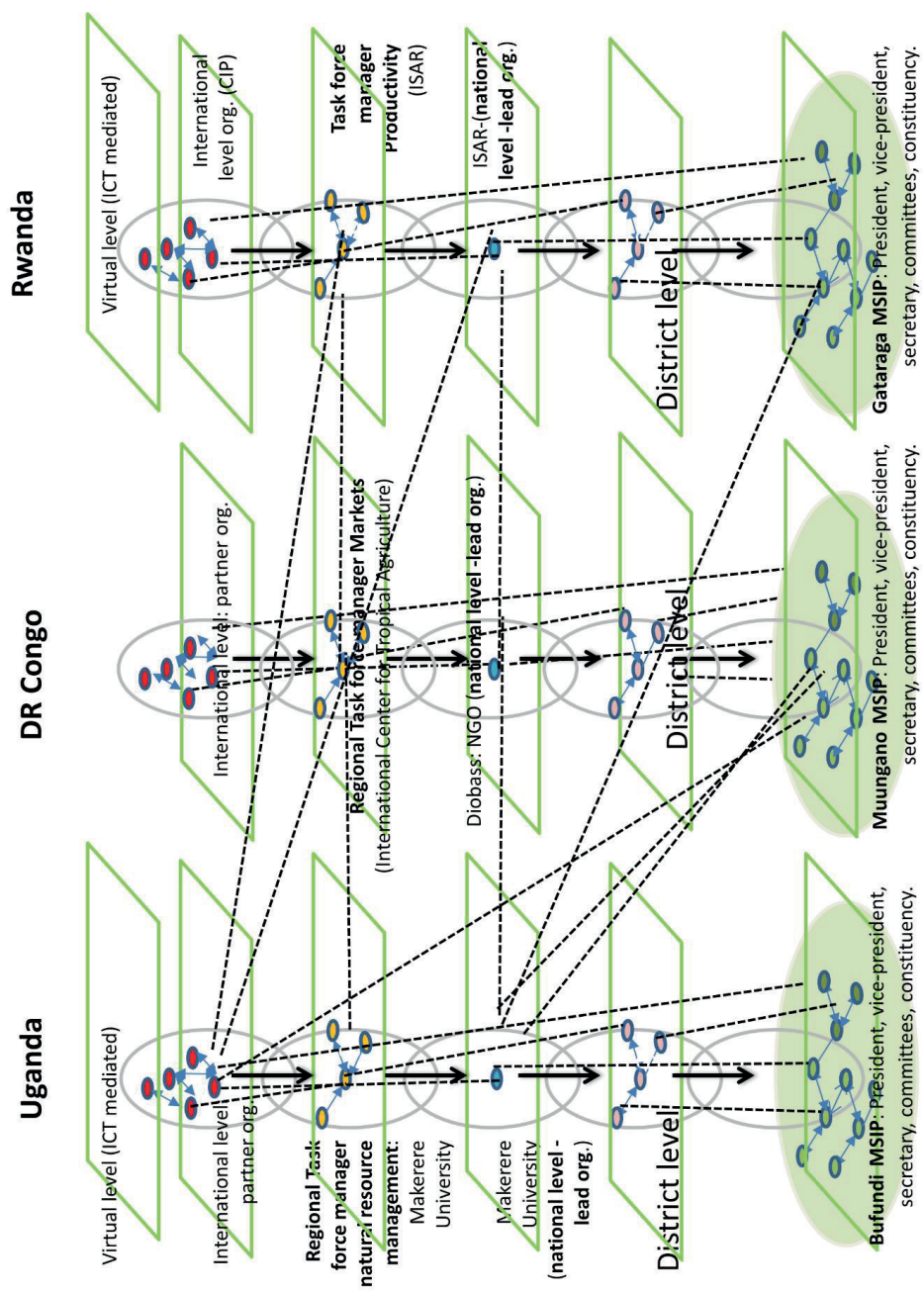


Figure 4.8 Dynamic hybrid coordination mechanisms (meta-governance) and interdependencies over time

As new challenges emerged, the configurations of actors participating in innovation networks of the potato netchain changed accordingly. Mobility in the innovation process was fostered to balance exploration and exploitation; there was a dynamic orchestration of activities facilitated by the multi-level fora of the MSIP (i.e. *mobile hubs* of innovation networks) at the farmer, national, regional and even the virtual levels (Figure 4.8). The fora democratically decided on the activities to carry out and the types of leadership required for specific tasks.



Source: Silvia Andrea Perez Perdomo, do not use without permission of author

Figure 4.9 Multi-stakeholder cooperatives and their different organizational relationships – reciprocal, sequential and pooled

In organizational ambidexterity, exploration and exploitation have to be combined to add value to organizations, and this is one of the most important conditions. The study found that at the level of innovation networks, a multi-stakeholder cooperative and its ambidextrous management through hybrid coordination mechanisms progressively foster the innovation capacity of farmers (and other actors) who cooperate in the innovation network. An ambidextrous management of a multi-stakeholder cooperative differs from other ways of management that tend to focus more on exploration or exploitation; it balances exploration and exploitation in the cooperative, and it solves interface problems that take place when managing simultaneously exploration and exploitation. However, management of innovation processes is interpreted in the sense of facilitating a process rather than controlling it, because the dynamics of innovation networks cannot be totally pre-planned but also follow mechanisms of self-organization and adaptation. Some of the roles of managers and other more informal actors from civil society:

- facilitating dynamic coordination according to innovation challenges, avoiding stagnation of the innovation process;
- fostering *bonding*, *bridging* and *breaching* mechanisms, to avoid the stagnation of networks and promote the emergence of new innovations – this implies facilitating inter-organizational relationships among stakeholders (reciprocal, sequential and pooled), particularly by making the supply, value or network more inclusive of small farmers, and can also imply the facilitation of exploitative and explorative alliances;
- combining tacit and codified knowledge sharing in communities of practice at different levels of innovation networks;
- facilitating new start-ups when the innovation process stagnates, and helping the opening (differentiation) and closing (consolidation) of networks when facing, short-, medium- and long-term challenges;

- managing the dynamics of innovation networks that include competing institutions and directing them towards more amicable environments, as innovation is a context-sensitive process.

The roles of intervention managers and innovation agents are crucial in the management of innovation networks of multi-stakeholder cooperatives over time.

This paper has presented a scenario of opportunities for the 82 percent of African farmers who potentially could participate in multi-stakeholder cooperatives as incubators of innovation and entrepreneurship, to develop their innovation capacity to face current complex challenges and societal paradoxes in cooperation with other stakeholders. New, innovative social arrangements have to be made to benefit the majority and avoid narrow approaches to innovation. A door is open for the opportunities that globalized and international markets offer to farmers not only in Africa but also other developing countries. Possibilities for change are left in the hands of the people who have the power to create and operationalize better policies, design interventions and invest more in better livelihoods for the majority of farmers who still struggle to make a living from agriculture.

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Chapter 5. Testing the effectiveness of network governance mechanisms to foster ambidexterity of agricultural innovation networks in east and central Africa⁶

⁶ Based on an article published as:

PÉREZ PERDOMO, S. A., FARROW, A., TRIENEKENS, J. H. OMTA, S. W. F. & VAN DER VELDE, G., 2017. Testing the effectiveness of network governance mechanisms to foster ambidexterity of agricultural innovation networks in east and central Africa. *International Journal on Food System Dynamics*, 8, 81-95.

5.1 Introduction

Nine out of every ten farms in the world are family farms, and the majority of these are in developing countries. Despite their engagement in agriculture these farming families represent 70% of the world's food insecure people due to insufficient production or a lack of money to purchase food (FAO, 2014). This paradox of rural food insecurity stems from a lack of natural resource management knowledge, power imbalances, lack of voice in decision making and asymmetrical access to resources such as information, technology, and agricultural inputs. Tackling these production and entrepreneurial challenges requires collaborative efforts of innovation networks of family farmers and other actors in agricultural value chains. Innovation networks are defined as a “temporary organisational hybrid phenomenon”, and “a new form of organisation within knowledge production for the exploration and exploitation of synergies and complementarities” (Pyka and Küppers, 2002). Ambidexterity is a concept that encompasses the routines and processes by which organizations organise their efforts and assets across different units (Jansen et al., 2009) for exploration and exploitation. Here we consider ambidexterity as a high order capability (Menguc and Auh, 2008) of innovation networks, which fosters other capabilities for supporting family farms to explore and exploit innovation opportunities.

Ambidexterity enables the agricultural innovation networks to mobilise, coordinate and integrate the capabilities of diverse stakeholders to innovate, and to allocate and combine agricultural technologies and knowledge across the family farms.

The debate on ambidexterity focuses on structural, temporal and contextual solutions (Stadler et al., 2014) —or challenges—for fostering simultaneous exploration and exploitation (Pérez Perdomo and Farrow, 2016, Pérez Perdomo et al., 2016). However, the structural challenges have received most attention of scholars of management and innovation theory given the effect of managing exploration and exploitation through different organisational structures (organisational ambidexterity) on the performance of organisations and firms (Cao et al., 2009b, Chang and Hughes, 2012). The management of structural challenges is an emerging area of

research in network settings (Pérez Perdomo and Farrow, 2016, Turner et al., 2013, Martini et al., 2013) and is strongly related to the structure, purpose and norms of the network, the acquirement and use of resources, the rules of engagement among partners and how the network partners are held accountable, i.e. the governance of the network (Alter and Hage, 1993, Provan and Kenis, 2008). Many studies have been unable to conclude which type of governance best enables family farms to foster capabilities to explore and exploit opportunities to innovate. Various authors suggest further research in order to arrive at general theories on how complex innovation networks build their ambidexterity (Turner et al., 2013, Martini et al., 2013, Mueller et al., 2013).

Hence in this paper we focus mainly on the structural challenges of managing exploration and exploitation in innovation networks (Pérez Perdomo and Farrow, 2016) with different forms of network governance. We empirically examine innovation trajectories among family farms in developing countries. We compare three types of network governance—first-order, second-order and meta-governance of multi-level networks—and the extent to which these prove successful in fostering family farms capabilities in their attempts to innovate. We analyse data on 2562 family farms in Uganda, Rwanda and the Democratic Republic of the Congo (DR Congo).

This paper is organised as follows. The next section discusses the notion of exploration and exploitation, and describes the concepts of first-order, second-order and meta-governance of multi-level innovation networks. Section 3 presents the data and methods. Section 4 examines the efficacy of first-order, second-order and multi-level networks. Section 5 concludes.

5.2 Exploration and exploitation

The governance of networks likely effects the management of exploration and exploitation of innovation opportunities. We relate three network governance mechanisms to exploration and exploitation management: i.e. first-order governance of small sized networks, second-order governance of large-sized networks, and multi-level networks with meta-governance.

5.2.1 First-order governance: exploration

First-order governance is characteristic of small sized networks with fewer than six to eight organizations (see participant governance in Provan and Kenis, 2008), and is particularly characteristic of exploration (Gilsing and Nootboom, 2006). Members of the network work together without hierarchy or higher levels of authority, have informal relationships and flexible ties that allow the entrance of new members to these locally embedded networks. Networks with first-order governance exhibit high levels of trust and a high density of connections (Gilsing and Nootboom, 2006), and have a limited use of contracts. These networks are sometimes coordinated without a formal management design (Pérez Perdomo et al., 2016, Pérez Perdomo and Farrow, 2016).

This governance represents the case of family farms that work as part of teams; collaborating in a local social network, community of practice, small producer organisations or even networks of practice aided by the use of information and communication technologies (e.g. mobile phones). We hypothesise that first-order governed networks effectively enable family farms to foster organisational capabilities to explore innovation opportunities. For instance, a family farm might join a small local innovation network to tackle common issues related to production, marketing, saving and credits.

5.2.2 Second-order governance: exploitation

Second-order governance is a characteristic of larger networks, where face to face communication is not easy, and a lead organisation is required for coordination, (Pérez Perdomo et al., 2016, Pérez Perdomo and Farrow, 2016). Networks tend to be more exclusive, with participants sustaining formal relationships, and with institution-based trust (Gilsing and Nootboom, 2006). This governance structure is not embedded in a context, and is based on a formal contractual relationship. Second-order governance favours the exploitation of capabilities because of the formal organisational relationships—whether by contracts or verbal agreements—

to assure the stability of the network, and access to the specialised knowledge base of a lead organisation (Pérez Perdomo and Farrow, 2016).

Second-order governance represents the case of family farms that work in a large network with a lead organisation coordinating the network to foster specialised capabilities (e.g. knowledge-extension, technological, entrepreneurial and investment capabilities) necessary for exploitation of innovation opportunities. An example is the conventional linear intervention programmes focussed on the diffusion of technological packages. Some of these National Agricultural Research and Extension Systems (NARES) programmes focus on the exploitation of particular technologies to improve competitiveness (Spielman, 2005). Other NARES intervention programmes help farmers build linkages and contacts to exploit innovation opportunities (e.g. Gildermacher et al., 2009, Kaaria et al., 2008, Sanginga et al., 2004). Knowledge management strategies include the use of information (didactic manuals, leaflets, etc. for codified knowledge) for facilitating the diffusion of the technology, and specific activities (e.g. training, demonstrations, and field visits) to consolidate specialised capabilities related to the diffusion of agricultural technologies.

We hypothesise that second-order networks effectively improve family farms' knowledge-extension, technological, entrepreneurial and investment capabilities necessary for exploiting innovation opportunities.

5.2.3 Multi-level innovation networks with meta-governance: exploration and exploitation

Meta-governance is less straightforward than first and second-order forms and concerns how exploration and exploitation are managed in multi-level innovation networks. Meta governance permits the simultaneous management of structural challenges of multi-level and sometimes geographically dispersed innovation networks, like international organisations (Schemeil, 2013), ambidextrous clusters (Ferrary, 2011), and global networks of practice (Agterberg et al., 2010). Meta-governance allows the emergence of sub-networks that are coordinated by mobile hubs of

innovation network members (Pérez Perdomo and Farrow, 2016). The governance, composition and organisation of the mobile hubs change according to particular challenges faced by the innovation networks at different times (Pérez Perdomo and Farrow, 2016). In contrast to a hub firm (Dhanaraj and Parkhe, 2006) or a *Network Administrative Organisation* (Provan and Kenis, 2008) that manages large and diverse participants and monitor its activities from a neutral and central position, meta-governance is not led by a single organisation or network broker that coordinates the whole network, in a centralised manner.

Meta-governance represents the case of family farms working as part of a multi-level network approach, like the Integrated Agricultural Research for Development (IAR4D) of the Sub-Saharan Africa Challenge Program (SSACP). Innovation networks that span multiple levels combine the input of various stakeholders in order to address multidimensional challenges (e.g. Buruchara et al., 2013, Hawkins et al., 2009, Cadilhon et al., 2016) and facilitate activities for helping family farms to build multiple capabilities to both explore and exploit opportunities to innovate. Important components of IAR4D for meta governance are the principle of participation by actors from multiple levels, a broad range of development objectives, and the innovation platforms where development challenges are identified, prioritised and action plans developed (Buruchara et al., 2013). Previous studies on impact pathways of SSACP innovation platforms (Nkonya et al., 2013) did not explicitly consider governance dynamics or the impacts on capabilities. Ambidexterity is a high order capability that entails multiple capabilities for both exploring and exploiting innovation opportunities. In the case of multi-level networks of innovation platforms we expect the participation and facilitation by diverse stakeholders would foster family farms' organisational, knowledge-extension, technological, entrepreneurial and investment capabilities.

This paper therefore examines how, and to what extent, the network governance mechanism fosters other capabilities of the network. More specifically:

What network governance mechanism of innovation networks best enable family farms in developing countries to foster capabilities for exploring and exploiting innovation opportunities?

We test the following hypotheses:

- Hypothesis 1. First-order governed innovation networks most adequately enable participating family farms to foster capabilities necessary for exploration of innovation opportunities;
- Hypothesis 2. Second-order governed innovation networks most adequately enable participating family farms to foster capabilities necessary for exploitation of innovation opportunities;
- Hypothesis 3. Multi-level innovation networks with meta-governance adequately enable participating family farms to foster capabilities necessary for exploration and exploitation of innovation opportunities.

5.3 Methods and Materials

We tested our hypotheses in the context of innovation networks in agricultural netchains in Sub-Saharan African countries. We used panel data of 2,562 households from two household surveys from 2008/09 and 2010, conducted in Uganda, the Democratic Republic of the Congo (DR Congo) and Rwanda. A longitudinal design allowed us to consider ambidexterity as a dynamic capability and to draw insights on how exactly innovation networks combined exploration and exploitation across family farms and across time (Simsek, 2009 pg. 889).

The panel data were from baseline and end line surveys conducted by the Sub-Saharan Africa Challenge Programme (SSACP). These surveys were designed to measure the impact of the Integrated Agricultural Research for Development approach (IAR4D) within the SSACP (Nkonya et al., 2013). The SSACP was designed to help family farms in Uganda, Rwanda and DR Congo foster capabilities to explore and exploit opportunities for innovation. The IAR4D organization structure consisted of managers at both the national and regional level. At the national level, managers coordinated activities aimed at improving family farms' market access,

productivity and natural resources management. At the regional level, the IAR4D programme institutionalized innovation networks, coordinated by local IAR4D committees. The regional innovation networks' activities were closely monitored by national IAR4D management. For managing temporal challenges, the IPs had monthly meetings to discuss and adjust actions plans, and monitoring and evaluation committees to keep track of the innovation process.

The surveys were distributed among households located in both the 12 SSACP Action Sites (in which innovation platforms were established as a component of IAR4D) and their 12 counterfactual sites (Farrow et al., 2013). In 2008, immediately prior to the baseline survey, villages in all sites were characterised by the levels of participation in AR4D interventions. Villages in counterfactual sites were categorised as 'First-order networks' if they had little or no participation in agricultural development interventions, or 'Second-order networks' if they had active participation in conventional AR4D interventions. All villages in Action Sites had little or no previous participation in agricultural development interventions and were categorised as 'Multi-level networks' because they would receive the IAR4D treatment, with a networked approach to connect local, national, and regional networks. One hundred and eighty villages were selected randomly with equal numbers of village types, with approximately ten family farm households selected randomly in each village.

Table 5.1. Number of family farms surveyed per country, by type of innovation network

	Uganda	Rwanda	DR Congo	Total
First-order networks	274	218	279	771
Second-order networks	266	220	291	777
Multi-level networks with meta-governance	271	224	190	685
Total	811	662	760	2233

5.3.1 Analytical approach and operationalisation

We hypothesised that the governance of first, second and multi-level innovation networks helps family farms foster different types of capabilities necessary for exploring and exploiting innovation opportunities. We distinguished between organisational, knowledge-extension, technological, entrepreneurial and investment capabilities (Table 5.2).

Table 5.2. Types of capabilities likely to be fostered per network type

Exploration/Exploitation	Type of capabilities	Type of Network		
		First-order network	Second-order network	Multi-level network
Exploration	Organisational	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Exploitation	Knowledge-extension		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Technological		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Entrepreneurial		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Investment		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

We analysed the change in capabilities at the family farm level, thereby taking advantage of the longitudinal data structure.

As a proxy for family farms' *organisational capabilities* to explore innovation we tally-marked participation of family farms in regional social (V1), production (V2), agricultural processing

(V3), marketing (V4), cooperative (V5), and saving and credit groups (V6). Membership of differentiated groups indicated types of organisational relationships (formal-informal, for horizontal, vertical, cross integration in the netchain) and further enables the family farm to explore and exploit opportunities for innovation. These different organisational relationships are indicators of the management of structural challenges in multi-stakeholder innovation networks. We observed the type of support provided by the extension services supporting the innovation network. The family farms' *knowledge-extension capabilities* were assumed to improve for those farms that received agricultural extension visits (V7), those that had received a certain number of extension visits (V8), those that had participated in research demonstrations (V9) and those that had facilitation to access market information (V10).

We analysed family farms' *technological capabilities* by measuring the use of different technologies. Based on SSACP data analysis, we considered the use of soil and water technologies (V11), the use of soil fertility technologies (V12), the use of crop management technologies (V13), the use of improved crop varieties (V14) and the use of improved livestock breeds (V15), as indicative of the farms' adoption of technological capabilities necessary for exploitation.

We assessed *entrepreneurial capabilities* by the farms' existence of marketing contracts with groups or traders for consolidating as business networks (V16) and whether the farm has successfully arranged deals on the sale of cereal crops (V17), legume crops (V18) and roots and tubers (V19). These variables indicate the consolidation of innovation networks as business networks exploiting capabilities to give an economic benefit.

As to *investment capabilities*, we used the farms' borrowing activity from informal sources of credit (V20) and borrowing activity from formal sources of credit (V21) to observe whether there was a change in their saving and credit status over time, which would indicate their investment capabilities.

For every single farm we calculated the change in the values of the variables V1 to V21 between the baseline (2008) and end line (2010) surveys. We use paired samples t-tests to establish statistically significant changes in the mean values between 2008 and 2010.

We tested whether first-order networks prove more efficient in improving family farms' organisational capabilities relative to second-order and multi-level innovation networks.

We expected second-order networks to improve the farmers' specialised knowledge, technological, entrepreneurial and investment capabilities. Multi-level networks with meta-governance were expected to help family farms build the combination of capabilities.

We used radar diagrams to plot the mean values for variables V1 to V21 for both the baseline and end line surveys. Changes in these variables can be read as pathways or cycles of innovation (Nooteboom, 2000, Van de Ven et al., 1999). Radar diagrams allowed us to consider ambidexterity as a dynamic capability by tracking changes in capabilities for exploration and exploitation over time.

5.4 Results

5.4.1 Baseline and End line capabilities comparisons

We observed a general improvement in family farms' *organisational capabilities*. There were significant changes in the membership of social (V1), production (V2) and saving and credit groups (V6). Changes in membership of agricultural processing (V3) and cooperative groups (V5) were not significant. The only significant deterioration in organisational capability was for group marketing (V4).

For *knowledge-extension capabilities*, there were a significantly higher number of farms receiving extension visits (V7) in 2010 compared to 2008. The number of visits (V8) for each farm also increased significantly and more farms participated in research demonstrations (V9),

which may be attributed to improved facilitation of extension services. However, overall fewer family farms had access to market information (V10) in 2010 than in 2008.

Contrary to expectations, family farms' *technological capabilities* (V11-15) decreased significantly during the 2008–2010 period. This result may be explained by the network already having completed the process of training in technologies in 2008. The changes in *entrepreneurial capabilities* were mixed, with small but significant decreases in group marketing contracts and sales of cereals (V16-17), but with larger and significant increases in sales of legumes and roots and tubers (V18-19).

There was a small effect on family farms' *investment capabilities*, with a significant reduction in formal sources of finance, but no change in borrowing from informal sources.

5.4.2 Types of networks and changes in capabilities

We hypothesise that improvement in organisational, knowledge-extension, technological and entrepreneurial capabilities differ by type of governance of the network. Results per type of network are shown in Table 5.3.

Table 5.3. Most favourable type of network governance per capability

Type of capabilities	Variables	Most favourable type of network governance
Organisational capabilities	V1 Member of social groups	First-order
	V2 Member of production groups	First-order
	V3 Member of agric. processing groups	
	V4 Participate in group marketing	
	V5 Member of cooperative group	Multi
	V6 Member of savings and credit groups	Multi
Knowledge-extension capabilities	V7 Received agricultural extension visits	Multi
	V8 Number of extension visits	Multi
	V9 Participated in research demonstrations	First-order
	V10 Access to market information	
Technological capabilities	V11 Used soil and water technology practices	
	V12 Used soil fertility technology practices	
	V13 Used crop management technology practices	
	V14 Used improved crop varieties	
	V15 Used improved livestock breeds	
Entrepreneurial capabilities	V16 Have marketing contract with groups or traders	
	V17 Sold cereal crops	
	V18 Sold legume crops	Second-order
	V19 Sold roots and tubers	Second-order
Investment capabilities	V20 Borrowed from informal sources	Second-order
	V21 Borrowed from formal sources	

We hypothesised that innovation networks with first-order governance most adequately enabled participating family farms to foster organisational capabilities necessary for exploration. We confirmed that first order governed networks enabled organisational capabilities for exploration, but also exploitation of innovation opportunities. First-order governed networks had a major improvement on membership of social groups, membership of production groups and membership of agricultural processing groups. These findings indicate an improvement in the management of structural challenges, fostering different types of integration of innovation networks (i.e. cross, horizontal, and vertical) for the exploration and exploitation of innovation opportunities.

We found that organisational capabilities for exploration and exploitation of innovation

opportunities (V1) were greater in both first-order and in meta-governance networks, than in networks with second-order governance. Meta-governed networks experienced a slight improvement in membership of cooperative groups and membership of saving and credits groups, which again indicated more cross, horizontal, and vertical integration of innovation networks, although differently to first order governed networks. Meta-governed networks fostered the membership to cooperative groups and also to credit and saving organisations, which are formal types of organisational relationships that can support the consolidation of business networks. In comparison, the first order governed networks fostered organisational capabilities by improving the membership to social groups in general, and the membership to production groups.

For participation in cooperative groups, both the first and second-order governance treatments experienced a significant decrease, while in the meta-governance there was a slight improvement.

Our second hypothesis was that larger innovation networks with second-order governance were more likely to foster specialised capabilities for exploitation (e.g. knowledge-extension, technological, entrepreneurial or investment capabilities) than networks with first-order governance. For the knowledge-extension variables (V7 – V10), the second-order governed networks were not more successful at fostering capabilities than the other types of network governance. The most favourable type of network governance for extension visits was the multi-level network, whereas the first-order governed networks led to the most improved participation in research demonstrations. Access to market information was universally worse in 2010 than in 2008, significantly so in the case of meta-governed networks.

None of the three networks improved the technological capabilities of farms; instead there was a significant deterioration in the use of technologies (V11 – V15) in all networks between 2008

and 2010. Regarding *entrepreneurial capabilities* (V16 – V19) the network governance that indicated most improvement between 2008/09 and 2010 was the second-order governed networks, which improved most on the variables of sales of legume crops and roots and tubers (V18-V19).

For *investment capabilities*, mean changes in households' access to informal sources to credit (V20) were significantly different among innovation networks with different governance.

Second-order governed networks had an increase in borrowing from informal sources, with a smaller increase in the first-order governance networks and a significant decrease for farms in meta-governed networks. Borrowing from formal sources of credit (V21) decreased in all three networks, with a significant change for farms in first-order governed networks.

5.4.3 Multiple capabilities for exploration and exploitation

We hypothesised that innovation networks with meta-governance would be more likely to foster multiple capabilities compared to networks with other governance.

For *organisational capabilities*, IPs with meta-governance improved the membership of the family farm to agricultural processing groups, cooperative groups and member of savings and credit groups. Therefore, the innovation networks with meta-governance of multi-level networks did foster effectively organisational capabilities for both exploitation and exploitation.

In relation to *knowledge-extension capabilities*, the IP meta-governed networks had the highest average positive change in the number of extension visits, followed by the first-order governance and second-order governed networks.

Regarding *technological capabilities*, in the period from 2008 to 2010 there was a mean reduction in the use of various technologies in all three treatments. For *entrepreneurial capabilities* the IP had marginally fewer households with contracts in 2010 than in 2008, whereas households in the first-order networks had marginally more households with contracts. For none of the other variables indicating entrepreneurial capabilities was the change in the IP households bigger than the other two governance types.

On *investment capabilities*, IP households had a smaller reduction in borrowing from formal sources than the second and first-order governance, and it was the only governance that reduced borrowing from informal sources. These changes could be due to cooperative affiliation or the loans provided by a partner of the IP in DR Congo to farmers in IPs in DR Congo, Uganda and Rwanda without the requisite of collateral. Informal sources of credit from family and friends are generally how farmers arrange their finances (Meyer, 2015), given that banks ask for collateral, a condition farmers find difficult to comply with.

5.5 Discussion and Conclusions

In this paper the results indicate that network governance does not have a significant effect on performance, in this case on fostering capabilities of networks to support family farms for exploring and exploiting innovation opportunities. The absolute values of the capabilities summarised in radar diagrams (Figure 5.1) show the evolution of capabilities. We observed that although the meta-governed networks had similar trajectories, this governance was more effective in combining multiple capabilities for both exploring and exploiting innovation opportunities rather in fostering specific capabilities.

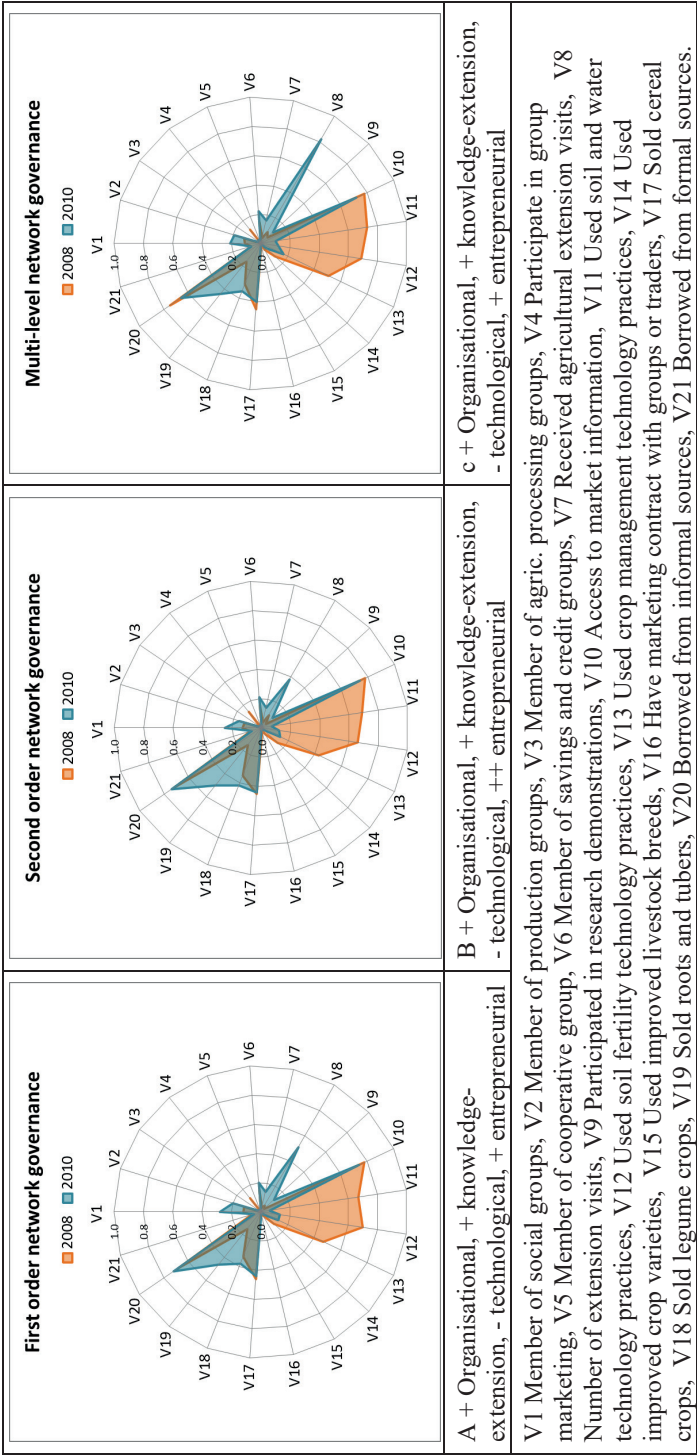


Figure 5.1. Tracking innovation pathways of innovation networks and network capabilities

Capabilities might evolve over time and complete a cycle; starting with organisational (exploration), then more specialised capabilities: knowledge-extension capabilities technological capabilities, entrepreneurial, and investment capabilities (exploitation), which make possible to continue the innovation process.

The results indicate that organisational capabilities for exploration (V1) were greater in first-order networks and meta-governed networks than in networks with second-order governance.

We also presented evidence of first-order governed networks enabling capabilities for exploitation, fostering organisational and entrepreneurial capabilities for consolidating business networks, with more marketing contracts with groups or traders. These results confirm similar findings of small networks in potato netchains (Pérez Perdomo et al., 2016) fostering exploration and exploitation (ambidexterity). Organisational and entrepreneurial capabilities of first-order and meta-governed networks could have been fostered with the increased membership of cooperatives and the provision of various services. Financial services provided by cooperatives (e.g. Saving and Credit Cooperatives [SACCOs] in Uganda) could have improved the investment capabilities of farmers and foster the emergence of small and medium size enterprises.

Second-order governed networks were significantly better for fostering just some few specialised capabilities for exploitation of opportunities for innovation (e.g. entrepreneurial and investment capabilities). Therefore, we could not confirm our second hypothesis. The results presented can be due to limitations of some sub-Saharan countries on the availability and/or coverage of specialised leading organisations that can contribute to exploitation of innovation opportunities by family farms (e.g. extension agencies, financial organisations and other specialised service providers). For instance, we observed a decrease in the provision of market information in all the cases, which is gap that could be filled by a lead organisation that specialises in offering this service more effectively and timely. Results can also be due to the emergence of collective roles and the diversification of roles played by organisations participating in collaborative innovation networks that are filling some of the gaps of the mentioned lack of specialised leading organisations.

With regards to our third hypothesis, our results indicate that while *meta-governed innovation networks* were not the most effective in building specific capabilities, they were effective at

building multiple capabilities, enabling participating family farms to build a combination of capabilities necessary for exploration and exploitation of innovation opportunities.

Multi-level innovation networks (meta-governance) were governed through mobile hubs that coordinated the exploration and exploitation of synergies and complementarities of geographically dispersed multi-stakeholder innovation networks. The IP was a social innovation for agricultural research and development that changed the traditional linear technology transfer approach for a networked approach.

While network governance had an influence on the capabilities of the innovation networks in which family farms were embedded, the moderately significant results (95%) suggest that governance is not the most crucial factor enabling family farms in developing countries to foster capabilities necessary for exploring and exploiting innovation opportunities. Therefore, differently to how it is in organisations, governance is not *per se* a solution to the paradoxes that exploration and exploitation represent in practice (cf. Volberda, 1998, Stadler et al., 2014). In complex settings like innovation networks in developing countries, network governance by itself is unlikely to solve other potentially complex barriers for exploration and exploitation. Network governance is a capability to manage a combination of challenges (structural, contextual, temporal). Therefore, we should consider the interplay between network governance and multiple variables over an innovation process. This would allow us to measure more accurately the effect of network governance on fostering capabilities over time.

Each country in our study has its own particular institutional dynamics that may have affected the management of multi-level networks, and therefore the effectiveness to foster capabilities.

In the province of North Kivu in DR Congo, civil war, lack of trust, limited financial and human resources, absence of a national agricultural extension policy and strategy (Ragasa et al., 2016), and poor basic infrastructure affect the fostering of financial, organisational and knowledge-extension capabilities of the innovation networks. The institutional-political arena—in which

major decision making is made— can help or hinder network governance and its effectiveness to

foster capabilities for exploration-exploitation. Uganda is characterised by decentralisation, which facilitates mobilisation, possibilities of self-governance, and a political arena created at the district level to participate in the ‘politics of development’ (Asiimwe and Musisi, 2007).

However, this political arena also generates an environment of competition for leadership (Asiimwe and Musisi, 2007), which can undermine processes of fostering capabilities for innovation. For example (Pérez Perdomo et al., 2016) found that agreements made in an innovation platform were insufficient to resolve competing claims between potato growers and pastoralists. According to farmers, the negotiations failed due to a lack of involvement from higher (district) levels of leadership to make agreements operational. As with international organisations that aim to tackle global challenges, the findings of (Pérez Perdomo et al., 2016) indicate the importance of a dual decision making structures in multi-level innovation networks to couple the technical with the political agendas in an adaptive manner (Schemeil, 2013). In Rwanda there are also some counter-productive institutional dynamics that may have influenced the fostering of capabilities. The Rwandan government has been proposing macro-economic strategies, which are expected to eventually benefit a majority of small and poor farmers. However, the promotion of crop specialisation and fertilization associated with those strategies is contrary to the prevailing polyculture system practiced by Rwandan farmers (Dawson et al., 2016). This decoupling of the technical and institutional realms discourages the managerial efforts for fostering capabilities of family farms.

These insights echo other findings on the context sensitiveness of innovation processes, and the importance of institutional environments to foster innovation (Mueller et al., 2013). It is necessary to assess the different technical, institutional, physical and other multiple characteristics of the context, which effect might represent drivers of or barriers to foster ambidexterity of agricultural innovation networks.

A factual limitation in our study was the difficulty of accurately measuring the effect of the IP, given that these were embedded in local governance mechanisms, and there might be a combined effect of the first and other governance network levels. The research design did not control for this effect, like taking a sample of people not members of the IP in the same place where the IP was established. The panel data did not track more systematically the influence of other possible interventions and dynamics. The second and first-order governance networks also might have had a strategy and facilitation of multi-level networks, but there was no tracking of such dynamics in a systematic manner in the panel data and complementary studies to compare. Another limitation is that the data did not specify the scale (local, regional, national or international levels) at which organisational relationships took place, perhaps underestimating the capabilities of meta-governed networks.

More monitoring and evaluation and longitudinal case studies in all sites would have given more in-depth data to track changes over time. According to the presented results, it is clear that fostering capabilities certainly takes more than two years to produce statistically significant changes. Further research is recommended to test capabilities using longitudinal data of at least a 10 year period (Alpkan et al., 2012) to measure the process of emergence of different capabilities over time. We provided the radar tool to show the results on capabilities as innovation pathways, which we hope would be useful as an analytical tool of innovation dynamics.

We suggest further research on the management of structural challenges of innovation networks through different network governance mechanisms and the importance of context on capabilities for exploration and exploitation. We recommend looking at the context as a mediating factor between network governance and capabilities as outcomes of the innovation process. The context itself is a multi-dimensional concept, and needs to be redefined in order to assess accurately to what extent the context fosters or hinders the governance capability and other capabilities for ambidexterity of innovation networks. This is a key consideration for public management of

Testing the effectiveness of network governance mechanisms to foster ambidexterity of agricultural innovation networks in east and central Africa

increasingly international multi-level innovation networks that collectively tackle global challenges.

Chapter 6. Synthesis and conclusions: contributions to theory and practice

6.1 Introduction

This research presents insights on ambidexterity as a capability of innovation networks to tackle challenges in innovation processes and also contributes empirical evidence of developing countries. Insights are expected to contribute to both theory and practice for the management of multi-level innovation networks to foster network capabilities, for the exploration and exploitation of innovation opportunities in innovation processes.

In this last chapter I summarise and discuss the contributions in relation to the research questions addressed in each of the main chapters. I then conclude with a first step towards a theoretical framework which highlights three main components of ambidexterity in innovation processes. I finalise with some suggestions for future research and some practical recommendations.

6.2 Synthesis

6.2.1 *Ambidexterity and innovation*

The systematic literature review contributes to a better understanding and applicability of ambidexterity for innovation in contexts other than organisations, and connects ambidexterity with other very diverse themes. Thematic diversity led Durisin and Todorova (2012) to describe ambidexterity as a concept “with blurry connections in existing theories”, and this diversity hampers the understanding as well as the applicability of the concept in practice.

The systematic literature review addresses the following research questions:

In which journals, settings and countries and on which units of analysis have studies on ambidexterity been conducted?

What are the main themes and the emerging themes in studies on ambidexterity?

What gaps are found in the literature of ambidexterity?

The majority of studies of ambidexterity have been conducted in organisations in developed countries. However, the review exposed studies at numerous levels of analysis (individuals, teams, organisations, clusters and information and communication virtually media), with

networks spanning all those levels and media. These multiple levels of analysis demonstrated that ambidexterity is being pursued by multiple societal actors.

Three ‘solutions’ were commonly proposed to manage exploration and exploitation: structural, contextual and temporal. However, in practice these ‘solutions’ were found to be challenges for managers related to the coordination of contradictory activities and complex tasks such as managing relationships, and fostering stability and flux in the innovation process, undertaken within physical, cultural and institutional boundaries.

The systematic literature review added value through the identification of a diversity of themes related to ambidexterity, and particularly identified the gaps that guide my research in the other chapters of this thesis. The 21st century is characterised by a complex combination of challenges that need to be tackled collectively by multiple stakeholders. A crucial gap that emerged from my review is a need to take a capability view when analysing ambidexterity in multi-level networks tackling complex challenges.

A capability view perceives ambidexterity as a dynamic capability of networks that relates to other network capabilities, which influences the outcomes of innovation processes. This is tested in chapter five, looking at how governance of innovation networks (management of structural challenges) influenced the fostering of certain capabilities of innovation networks.

6.2.2 Roles in agricultural netchains to foster ambidexterity

The review shows that the roles played maintain dynamism in the management of exploration and exploitation at the network level. Roles traditionally played by formal managers are now also played by other civil society actors from different productive sectors. How these roles change over the innovation process and how they foster capabilities for ambidexterity of innovation networks is thus an area for further research. Chapter 3 addresses this gap, and contributes empirical evidence from developing countries. The research question addressed was:

What roles are played and by whom to foster ambidexterity in netchains for tackling challenges faced by smallholder farmers in Sub-Saharan African countries?

Chapter three presents case studies from the Sub-Saharan African smallholder agricultural sector, in which multiple and often complex challenges are tackled through collective action. The units of analysis of the six cases are smallholder farmer groups participating in potato netchains in Uganda, Rwanda and the Democratic Republic of the Congo. The netchains have different configurations of innovation networks, with different research and development interventions, and multi-stakeholder-innovation platforms. The studies identify and describe pooled, reciprocal and sequential relationships among stakeholders participating in multi-level innovation networks. Consequently, we characterised the innovation networks as exploratory, exploitative or ambidextrous, depending on the types of organisational relationships sustained among the stakeholders. The chapter reports how netchain analysis was adjusted to track both the roles of stakeholder in each case study, and the changes in roles along the innovation trajectory. Structural, temporal and contextual challenges are interrelated and require the input from various stakeholders to make the innovation processes more effective. The chapter revealed that in Sub-Saharan Africa there is a diversity of stakeholders (e.g. farmers, wholesalers, researchers, policy-makers, and financial service providers), within multi-level innovation networks helping small farmers to overcome food insecurity and poverty. Roles were played by those different stakeholders at multiple network levels—individuals, leaders, champions, teams and clusters. At the individual level, traditional roles (e.g. extension) played informally by non-traditional actors like community leaders and ‘champion’ farmers were identified. In some cases, the roles played by individuals evolved from their traditional role to a novel role e.g. from farmer to trader. The roles of some stakeholders at the team and organisational level focused on exploration (e.g. knowledge sharing, network building, and communication), while others concentrated on exploitation (e.g. formalising agreements, linking farmers to markets, and lending capital). However, it was found evidence of the aggregation of roles, played collectively by stakeholders in innovation platforms to foster ambidexterity. Collective roles in multi-stakeholder innovation platforms optimise the use of scarce resources, and join stakeholders’ capabilities synergistically

filling in each other's gaps, with some actors providing technologies, some inputs for agriculture, and others offering services and sharing knowledge. Collective roles fill in some gaps of the 'system' and traditional roles when these are dysfunctional or do not have the capacity and coverage.

A multi-stakeholder innovation platform is an example of network orchestration in innovation networks (Dhanaraj and Parkhe, 2006). The platform could also be considered as a systemic innovation broker (Klerkx et al., 2009), however, the platform does not represent a neutral party in the orchestration of innovation networks. Instead the innovation platform was found to be a space for the emergence of 'mobile hubs' of innovation networks, which dynamically change its goals, the stakeholders, relationships and strategies over the innovation process. Every stakeholder has a 'stake' to negotiate, and activities are planned according to these negotiations. The mobile hubs apply the principle of innovation platforms of having a participatory decision-making structure and a monitoring and evaluation system for more legitimacy and accountability in the innovation process.

6.2.3 Governance and coordination to balance exploration and exploitation in multi-stakeholder cooperatives

The fourth chapter of this thesis presents multi-stakeholder platforms and their evolution and consolidation as a special type of a multi stakeholder and multipurpose -cooperative, an incubator of innovation, and as an example of emergent new business models and collective entrepreneurship (Iliopoulos et al., 2016).

Cooperatives serve both social and economic collective purposes and the members of cooperatives are at the same time owners and users. This dual character leads to ambiguity, and the contradictory activities of cooperatives can make their coordination problematic, especially when cooperatives involve multi-level innovation networks, with a diversity of stakeholders. Specific problems include how to coordinate stakeholders that have different interests, and

different competing institutional frameworks, professional backgrounds or culture. Likewise, it is necessary to resolve paradoxes associated with the users of cooperatives being accountable to themselves as owners. Further problems relate to maintaining the stable participation of members to comply with contract conditions (e.g. production and quality demands), and at the same time open the network to new members according to the principle of open ownership.

Consequently, the research question addressed in this chapter is:

How are innovation networks that co-operate with smallholder farmers coordinated to balance exploration and exploitation when tackling collective challenges in an innovation process, and through which network governance coordination mechanisms?

This chapter contributes empirical evidence and new insights on network orchestration in the context of agricultural netchains, adding to previous work by Batterink et al. (2010) and Dhanaraj and Parkhe (2006) on network orchestration processes. Network orchestration is needed for coordinating collective efforts over the innovation process. From the six case studies three network governance mechanisms were proposed to manage the structural challenges of exploration and exploitation: (1) first order governed networks; (2) second order governance of larger networks, and; (3) meta-governance of multi-level innovation platforms. The same six potato netchains as in chapter three were studied, adjusting social network and netchain analysis methods for tracking those network governance dynamics.

The ambidextrous management of the multi-stakeholder cooperatives balanced exploration and exploitation dynamics of the innovation process. Multi-stakeholder innovation platforms simultaneously supported not only learning but also economic related activities. As a multi-purpose type of cooperative, multi-stakeholder innovation platforms followed the main principles of cooperatives, with new self-help organisational forms allowing family farms to tackle challenges like food insecurity and particularly poverty through economic empowerment. The platforms had voluntary and open membership; they ensured the stability and flux of the networks with new members incorporating new resources and sources of knowledge. The

platforms were characterised by democratic member control, and were an interface for decision making, negotiation, monitoring and evaluation, design and remaking of actions plans of the innovation process. The members of the platforms participated economically, with the platforms allowing the consolidation of business and other formal partnerships. The platforms were autonomous and independent, and were an interface for building institutions, new ways of governance, with sanctions and rewards for members. The platforms managed the knowledge resources, contributing to the education, and training of the stakeholders. The platforms also co-operated among themselves via the local, national, regional and international organisations that joined the innovation network. Finally, the platforms displayed a concern for the community, and in this case a community of stakeholders at different network levels and countries.

Multi-stakeholder innovation platforms foster new ways of knowledge production, but are also a special type of multi-purpose cooperative with hybrid and dynamic governance mechanisms to manage international business networks. A dynamic orchestration of activities is facilitated by fora that emerge at different levels in multi-stakeholder innovation platforms, i.e. mobile hubs of innovation networks. Decisions are taken democratically by these mobile hubs to decide on the modes of governance and leadership required for coordinating activities at different network levels. The mobile hubs decide when, how and by whom challenges are going to be tackled e.g. by a lead organisation, or a combination of organisations.

Some findings of this chapter relate to the managements of commons (Ostrom, 1990), particularly contributing empirical evidence on how communities co-operate to share resources. Similarly, the chapter provides insights on new ways of how these commons are governed in multi-stakeholder networks in the context of innovation processes. Mobile hubs are interfaces and collective governance mechanisms to manage the resources of multi-stakeholder networks at different levels. These resources are not solely natural, but include knowledge and any other resources necessary for fostering capabilities for the exploration and exploitation of innovation opportunities. This thesis emphasises the need to manage the commons not just locally but at

multiple network levels, and the need to see its interplay and its embeddedness in the geographical, social, institutional and even virtual context of the innovation process. Politics were observed as an institutional factor that hindered the effective management of multilevel commons. An example from chapter three was the Ugandan case of Bufundi where local norms were disconnected from norms at other levels. Decentralisation has given the power to the local commons, but it is disconnected from higher levels of decision making at government, which has been shown to be counterproductive for innovation. Mobile hubs at different levels should connect multi-stakeholder networks and adjust to contextual dynamics over time. These insights are important not only for research and development innovation networks that intend to tackle challenges of family farms, but for other types of multi-level settings in which the coordination of multiple stakeholders by mobile hubs is key for the management of commons.

6.2.4 Network governance to foster capabilities in innovation processes

In this thesis evidence on ambidexterity of innovation networks as a higher order collective managerial capability is presented, and the influence of governance on the outcomes of networks, specifically their capabilities. The literature review in chapter two identified a gap on assessing the effectiveness of network governance for the exploration and exploitation of innovation opportunities, particularly in fostering the capabilities of family farms. The fifth chapter of this thesis makes a contribution and proposes a new perspective for studying and assessing the outcomes of innovation networks in open innovation processes in sub-Saharan Africa. It presents evidence of the governance of innovation networks to foster capabilities that benefit not only family farms but the whole network.

There are a large number of studies of interventions for rural innovation, and in particular on innovation platforms. Very few assessments of the impact of interventions consider network capabilities as outcomes of an innovation process. In the fifth chapter it is tested how different modes of network governance influence the outcomes of the innovation process. It is analysed the effect of different modes of networks governance on the evolution of network capabilities

over time, to fill in the gap of longitudinal studies on ambidexterity. In this chapter a panel dataset of households from the Democratic Republic of the Congo, Rwanda and Uganda is used to answer the following research question:

What governance mechanisms of innovation networks best enable family farms in developing countries to foster capabilities for exploring and exploiting innovation opportunities?

The three innovation network governance mechanisms identified in the fourth chapter for exploring and exploiting innovation opportunities were tested. It was found that first-order governed networks built capabilities for exploitation as well as exploration, while second-order governed networks fostered specialised capabilities for exploitation. Meta-governed innovation networks were most effective in combining multiple capabilities for exploration and exploitation. However, the results indicate that governance mainly oriented to the management of structural challenges is not sufficient to foster ambidexterity of innovation networks. Instead there is interplay of structural, contextual and temporal challenges, and governance as a capability for an ambidextrous management. Further research on the context as a mediating factor between governance and capabilities is recommended.

Network governance is a managerial capability that can foster other network capabilities. Depending on the governance, certain network capabilities can be fostered at one or multiple levels of the netchain, as shown in chapter three on roles. Innovation networks in open innovation processes can be organised through separated and combined social structures. Instead of work units of organisations (such as in large firms), there are groups of organisations that work together to explore capabilities (exploratory networks), to exploit capabilities (exploitative networks), or both explore and exploit (ambidextrous networks) as explained in chapter 3 on roles. Network governance can also facilitate network mobility in the orchestration of multi-level innovation networks for dynamism of exploration and exploitation in the innovation process (i.e. meta-governance).

In *first order governed networks*, it was found that exploration and exploitation were combined and performed positively. First order governance in small and medium innovation networks fostered organisational and entrepreneurial capabilities, for both exploration and exploitation for innovation, with an ambidextrous capability. This result was consistent with Chang and Hughes (2012) in their studies of small and medium enterprises. First order governance can be part of the meta-governance, but within meta-governance there is mobility among network levels (or spatially and even virtually mediated). This mobility is important for accessing new sources of knowledge and other resources that are not locally available.

Second order governance of larger networks fostered some limited specialised capabilities for exploitation.

Meta-governance of multi-level innovation platforms was found to be effective to foster multiple capabilities simultaneously. The multi-stakeholder innovation platform involved stakeholders at major levels of the netchains; synergies among the stakeholders facilitated the fostering of multiple capabilities.

This chapter contributes to previous insights on network governance by Provan and Kenis (2008), and evidence of orchestration of multi-level innovation networks in agricultural netchains, and the chapter adds a capability view. The findings suggest that in the context of interventions that aim to help family farmers, the network governance capability is important. Exerting a network governance capability for exploration and exploitation can help to optimise the use of resources (particularly knowledge) for fostering capabilities. However, the results presented are not robust and conclusive on how different governance of networks can influence the outcomes of the networks; structural governance alone is not a solution to ambidexterity of innovation networks. This finding contrasts with the situation in large firms in developed countries where the choice of governance mechanisms is important for fostering good outcomes. Governance as a managerial capability focused mainly on networking as a way of balancing exploration and exploitation (Mueller et al., 2013) is not always sufficient to tackle complex

challenges. Managing exploration and exploitation effectively might need a more ambidextrous management of structural, contextual and temporal challenges, which would require the network to have ‘govern-ability’ and sufficient resources.

6.3 Discussion

6.3.1 *Ambidexterity as a collective capability of multi-level innovation networks*

Based on the theoretical and empirical evidence, this thesis presents an overview (Figure 6.1) that integrates the multidimensional themes and multilevel units of analysis of ambidexterity. This overview is intended to be a first step towards a theoretical framework on ambidexterity for multi-level settings. This was a gap identified in the systematic literature review.

A theoretical framework is also important to guide the assessment of the performance of such multi-level network settings. The overview is from a perspective of multi-level networks rather than organisations, responding to Gupta et al. (2006) suggestion of examining how exploration and exploitation interact at different levels, and how this process is managed.

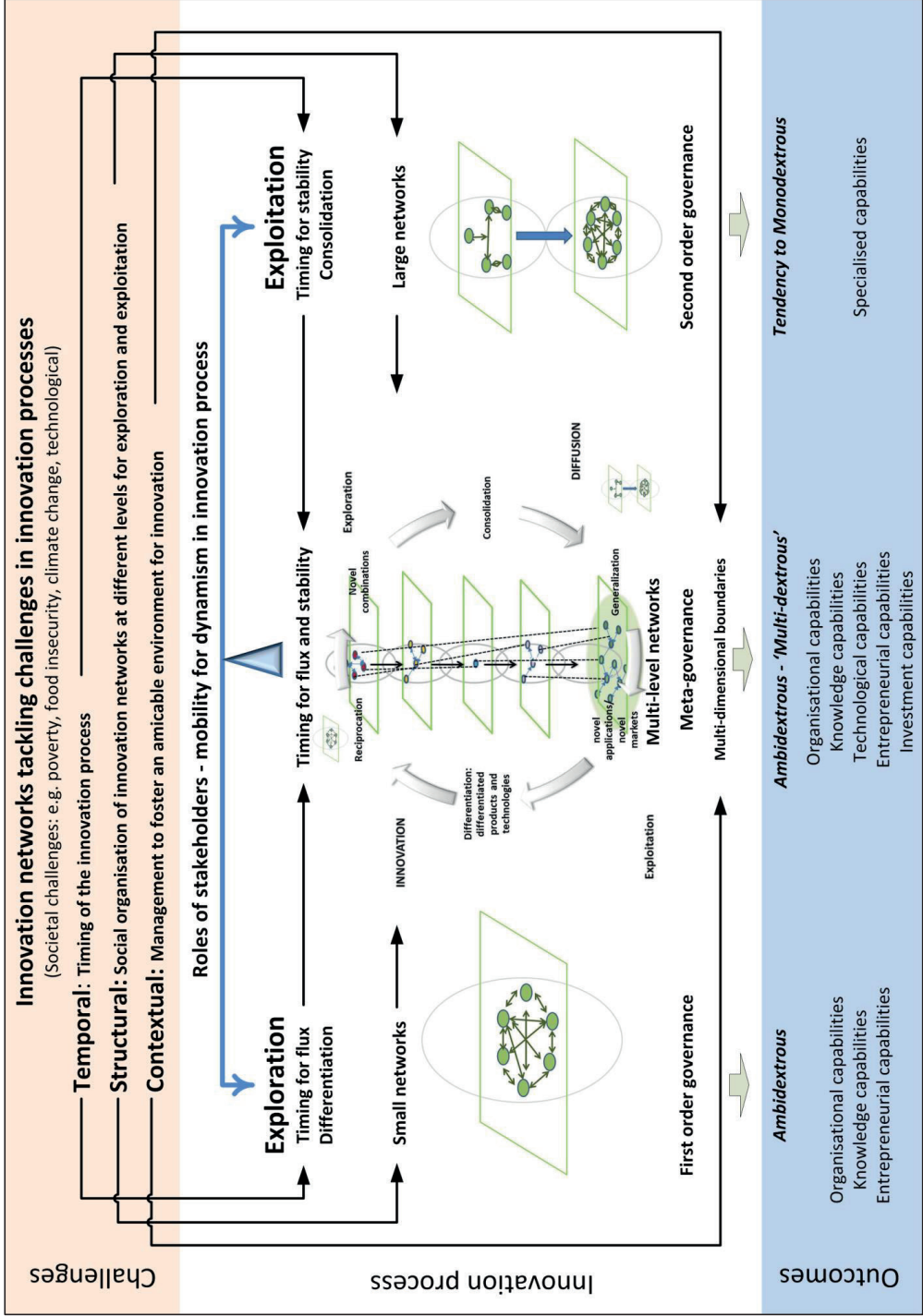


Figure 6.1 Overview of main themes on ambidexterity of multi-level innovation networks in open innovation processes.

The overview shows the general insights from the literature and from the empirical evidence presented in this thesis.

The first grouping in the overview comprises the challenges: structural, temporal and contextual. In the literature of organisational ambidexterity these are generally presented as separate and disconnected ‘solutions’. However, in the context of innovation processes it was found that instead of solutions these are instead interconnected challenges.

The second grouping in the overview concerns the innovation process as a cycle, in which mobility is proposed as crucial to maintain the dynamics of exploration and exploitation. As presented in the cases in chapter three, the roles of the traditional actors of systems of innovation, such as national extension services, are crucial for fostering specialised capabilities of farmers. However, there is the emergence of organisations that play these and many other roles, who contribute to innovation by responding to the lack of coverage of the traditional extension systems. The emergence of new actors reflects the dynamics of open innovation, in which a diversity of stakeholders, including from other contexts (e.g. Omta and Fortuin, 2013), contribute to innovation.

In the overview there are various societal levels of analysis of ambidexterity, with networks a new unit of analysis. These multi-level innovation networks have layers that can include individuals, champions, families, teams, organisations, communities/networks-of-practice, multi-stakeholder platforms and virtual levels.

The third grouping in the overview (Figure 6.1) is composed of the outcomes of the innovation process, using capabilities as indicators of performance of innovation networks. Chapter five tested how different ways of network governance fostered certain network capabilities (monodextrous, ambidextrous or even multi-dextrous), finding that networks tend to be multi-dextrous, given the synergies among actors and collective roles.

Differences in capabilities were found according to the innovation network governance (management of structural challenges) in developing countries, therefore governance influences

the outcomes on network capabilities. However, there were no conclusive results on how different governance of networks can influence their outcomes on capabilities. Results suggest the importance of governability, or capability to manage structural challenges within a certain environment with its multiple boundaries, while managing temporal challenges through keeping the process dynamic. Such ambidextrous management of those challenges might be crucial for fostering ambidexterity in open innovation processes of multi-level networks. Utilising a perspective of network capabilities means that not only the added value of synergies of collaborative innovation networks in innovation processes is assessed, but also their performance in relation to the challenges of particular contexts or territories and at different stages of the innovation process. These insights on ambidexterity contribute to complexity theory, by explaining how ambidexterity takes place in practice when tackling complex challenges in innovation processes. This thesis also contributed specific network capabilities for ambidexterity in innovation processes, complementing the work of Stadler et al. (2014) on capabilities, which are useful indicators to assess outcomes of multi-stakeholder processes.

6.3.2 Ambidextrous management and mobility for dynamism in innovation processes

The empirical evidence presented in this thesis suggests that structural, contextual and temporal challenges of exploration and exploitation are interconnected and need to be managed simultaneously. Management needs to consider how to organise the people, make the boundaries of the environment more amicable for innovation, and do this dynamically over time. In the third chapter empirical evidence was presented on the three types of challenges in agricultural netchains, and the roles of stakeholders in managing these challenges in multi-level innovation networks. It was observed how these inter-related challenges were tackled simultaneously and collectively by innovation networks, particularly in multi-stakeholder innovation platforms. Examples of where structural challenges were interlinked to contextual challenges included family farms connecting to other stakeholders of the network or the value chain (horizontal, vertical, and cross integration in the netchain). The ability of these family farms to make formal

linkages with traders and engage in business opportunities (contracts for exploitation) was affected by contextual challenges like the lack of infrastructure (e.g. in the case study of farmers in DR Congo). Likewise, institutional factors (e.g. not operational policies, weak institutions, cultural differences) were contextual challenges that affected a networking process (structural challenges management). In the case of Bufundi in Uganda, for instance, competing claims between agriculturalists and pastoralists impeded networking. Bylaws were developed locally to resolve this problem, but were never fully operationalised due to the lack of support from higher levels of government and due to some disconnection of local and national politics. Institutions can therefore become barriers to innovation when there is a lack of supportive institutional boundaries. Temporal challenges cut across structural and contextual challenges, and can add more complexity when the timing of exploration and exploitation is not managed effectively. For instance, the process in which farmers develop their capabilities to overcome food security and poverty can be interrupted by a lack of finance, affecting the continuity required for the consolidation of capabilities and the exploration of new ways of doing things in the innovation process.

Mobility is crucial to foster dynamism in the innovation process, and multi-stakeholder innovation platforms foster the emergence of mobile hubs of innovation. These mobile hubs are the interface for managing three types of mobility needed for dynamism in the innovation process: structural, contextual and temporal.

6.3.2.1 Interfaces for network governance—Structural mobility

Structural mobility refers to the capability of the innovation networks to connect to other stakeholders at different network levels, and maintain an appropriate diversity of stakeholders and organisational relationships over time.

In developed countries ambidexterity is managed effectively via combined units in large firms, separated work units in small and medium size enterprises, or through regional clusters for networks as presented in this thesis. These units, fora, or ‘hubs’ manage knowledge flows, and

have a tendency to be formal, centralised to share resources, static and neutral. In developing countries, it was found that the orchestration of innovation networks takes place in multi-stakeholder innovation platforms. Platforms tend to be complicated, include stakeholders from multiple levels sustaining informal and formal organisational relationships (e.g. pooled, reciprocal and sequential organisational relationships like in public and private partnerships), with the need to address very complex challenges simultaneously, having access to very limited resources. Consequently, it is difficult to establish a hub that is neutral, and central. In addition, in multi stakeholder platforms a static configuration of actors means no new input of knowledge. Hubs for managing knowledge flows must therefore be mobile—with changes in their composition and governance mode over time according to challenges—and this structural mobility should be managed collectively by the whole platform. The multi-stakeholder platform has a multi-layered and dynamic governance mechanism. It is also a space for negotiation in which it is crucial that various stakeholders join the platform to provide different viewpoints and benefit from synergies to tackle problems. In this space of the platforms, mobile hubs emerge as open fora with democratic ways of management to explore and exploit opportunities of innovation. Mobile hubs have a combination of formal and informal managerial structures for coordinating activities of multi-level innovation networks.

Network governance is then found to be a capability that can foster the structural network mobility in the orchestration of innovation networks, for knowledge mobility (Dhanaraj and Parkhe, 2006), which is important for the fostering of other network capabilities. Chapters 4 and 5 present examples of different network governance mechanisms that foster different organisational relationships for structural-network mobility in innovation processes.

6.3.2.2 Interfaces within multi-dimensional boundaries—Contextual mobility

Contextual mobility refers to the capability of the innovation networks to mobilise collective action towards achieving a more amicable environment for exploration and exploitation for effective innovation. In order to improve the context for innovation it is possible that the

boundary of the innovation network itself needs to change, for instance by including new stakeholders with other spheres of influence (e.g. national policy makers). Contextual mobility occurs within multiple and different types of boundaries—geographical, virtual, institutional, or political—by for instance creating policies, negotiating competing claims, or looking for sources for financing innovation, depending on the context, which was addressed in Chapter five. Chapter three of this thesis gives some examples of the roles required to manage contextual challenges.

The virtual boundary is a promising boundary of the environment of innovation. Exploring and exploiting opportunities by virtual innovation networks is a window of opportunity for innovation. Information and communication technologies (ICTs) such as mobile phones and the internet expedite exchange among global networks (electronic transactions, like transfer of information and money by mobile phones, communication via social media, etc.), broadening the boundaries of the innovation network and creating capabilities to innovate.

6.3.2.3 Interfaces for dynamism in an innovation process—Temporal mobility

Temporal mobility is the capability of the stakeholders in the innovation networks to ensure an appropriately dynamic innovation process. In multi-stakeholder innovation platforms, mobile hubs foster this dynamism (stability and flux) designing action plans for short, medium and long term activities, which are adjusted, monitored, assessed and changed when needed over the process (see chapter three). Temporal mobility requires enhanced capabilities of the innovation network to manage the timing of activities in the innovation process, and move appropriately between stages of exploration and exploitation, for flux and stability stages in the innovation process. In the case studies, two ways of timing of exploration and exploitation were appreciated. The first similar to continuity, like the case of Nyabyumba farmers in Uganda, participating in different interventions in a period of 15 years until the innovation network consolidated as a stable business network. One intervention was Farmer Field Schools, becoming a community of practice. For tackling specific challenges, exploratory/exploitative management might be

optional ways of management in short and medium-term innovation trajectories (for instance, for tackling lack of clean seeds, the positive selection was an effective way to foster knowledge and technological capabilities, with a medium-term trajectory). Another intervention was Enabling Rural Innovation (ERI), during which the group consolidated as a producer organisation for collective marketing. At the same time, they participated in activities to improve technological capabilities for better natural resource management, to access seeds, and training to comply with market standards for quality and quantity. As such, there was a simultaneous timing of exploration and exploitation (orthogonality), with certain organisations leading certain activities, and coordinated by the mobile hubs in the innovation platform. This is a case of orthogonal or simultaneous timing of exploration and exploitation that took place also in the cases of the IAR4D multi-stakeholder innovation platforms. The orthogonal timing of exploration and exploitation allowed the emergence of business networks in less time than if each activity was conducted sequentially.

However, the outcomes on fostering capabilities of multi-stakeholder innovation networks (like ERI or IAR4D) with meta-governance showed that, although multiple capabilities are being orchestrated simultaneously, capabilities were not fostered in the most effective manner compared to other types of governance of innovation networks. The results suggested that the performance on capabilities are context related and further research is required to form more robust insights.

6.3.3 Contributions to methodology and suggestions for further research

In terms of methodology, this thesis contributes a longitudinal approach to track the evolution of the management of exploration and exploitation in multi-level network settings, with a capability view for open innovation processes. Although various scholars define ambidexterity as a dynamic capability, there are few longitudinal studies that track how the evolution of ambidexterity takes place in practice, not by looking at causal and effect outcomes over time.

Regarding the outcomes of an innovation process, this thesis highlights the importance of network capabilities as indicators of for the assessment of innovation network performance.

This thesis contributes a longitudinal view on how ambidexterity takes place over time, the specific roles of stakeholders for exploration and exploitation, and present empirical evidence of the collective roles of stakeholders to foster ambidexterity over an innovation process.

The analytical framework of netchain analysis is adjusted to track the multi-level social architecture of innovation networks, the roles of multi-stakeholder at different levels and within diverse boundaries (e.g. international, regional, national, institutional) and the evolution of ambidexterity as a capability. The adjustment of netchain analysis allowed me to take a relational approach to track the roles of diverse stakeholders along the innovation process, to see changes in organisational relationships or alliances over time as indicators of governance mechanisms.

When tracking the interdependencies of netchain analysis (especially pooled interdependencies),

It was observed that the interdependencies classified by Lazzarini et al. (2001) should rather be named as organisational relationships since actors are not always interdependent. Complexity theory and innovation systems paradigm are based in principles of interdependency of actors, which implies that if one part of the system fails the whole system fails. A perspective on organisational relationships among networks is recommended to be used when studying innovation processes, as a less ambitious approach than a system perspective (Fagerberg, 2004).

This thesis has shown that the interdependency principle does not always apply in practice, and that the no interdependency at certain stages of the innovation process is important to avoid stagnation. Interdependency takes place among stakeholders whose output is interlinked to other stakeholder in the netchain (e.g. the value chain, the diffusion-adoption of a technology).

Consolidating and formalising interdependencies is important in the process of fostering specialised capabilities (e.g. entrepreneurial and technological capabilities). However, the lack of interdependent stakeholders benefits innovation. It avoids stagnation of the same actors, which might perpetuate some particular interests (in an established system, partnership, power abuses

of a regime, paternalistic way of doing things), and is important for exploration to guarantee new flow of resources, particularly knowledge as the base for fostering capabilities for exploration, exploitation and ultimate innovation. Dynamism in organisational relationships (alliances, partnerships, contractual relationships), i.e. structural mobility, is important for innovation.

This thesis combined qualitative and quantitative methods as recommended by some scholars (e.g. Gupta et al., 2006, Mueller et al., 2013) to capture the micro and macro dynamics of the management of exploration and exploitation, with a multi-network level and international contextual perspective.

6.4 Final remarks and more recommendations for further research

Developmental challenges are the ‘new commons’ that call for more engagement and coordination of innovation networks at local, national, regional and international levels. Tackling complex developmental challenges through innovation requires the consideration of multi-dimensional managerial challenges (structural, contextual, temporal) in innovation processes. Confronting developmental challenges also requires the collective roles that emerge in collaborative innovation networks when formal managers, informal civil society and other stakeholders at multiple network levels work in synergy. Every stakeholder in innovation networks has a ‘stake’ to negotiate, and ambidexterity is an important managerial collective capability in multi-stakeholder platforms to facilitate synergy among stakeholders.

An ambidextrous management and design of multi-stakeholder innovation platforms facilitates the emergence of mobile hubs of innovation networks when tackling specific developmental challenges. The hubs are interfaces to coordinate collective efforts across geographical and institutional dimensions of the network. These mobile hubs need to have governance capabilities to manage simultaneously structural, contextual and temporal challenges, and thereby add value to the innovation process. However, while mobile hubs serve as interfaces to coordinate collective efforts, insights from the case studies and the analysis of household panel data in this

thesis indicates that more coordinated efforts are required to improve some interfaces. For instance, improving the connection of local and national politics (in Uganda), or resolving a disconnection between cultural agricultural production norms and strategic policy responses (in Rwanda) discussed in Chapter 5. Therefore, more coordination for the management of structural challenges (e.g. linking local with national policymakers), contextual challenges (e.g. advocating for better policies), and temporal challenges (e.g. coordinating short-term and long-term action plans) are required for improved interfaces.

This thesis has shown that in innovation processes in which innovation networks aim to tackle developmental challenges of family farms, the lack of access to finance is a barrier to the continuity of activities for strengthening the capabilities of family farms. As a consequence, lack of access to finance impedes a cyclical and dynamic process needed for more sustainable innovations. Two questions that emerge are: (1) Who pays for fostering capabilities for sustainable exploration and exploitation for innovation? and, (2) How to manage the finances of multi-stakeholder innovation platforms which operate at different network levels (farmer level, national, regional, international, virtual), without having a specific program?

For the first question the roles of donors, international NGOs and private investors, and particularly public and private partnerships are key to allow innovation networks to mature and convert into business networks, for the consolidation of tangible benefits for family farms in developing countries. Here policies (e.g. cross-border trade, mobile banking) have an important role to facilitate partnerships, remove barriers and open safe spaces for exploration and exploitation, and ultimately innovation.

For the second question, financial resources for multi stakeholder innovation platforms could be managed through the local governance structures. These structures are stable, aware of community needs, capabilities, stage of development, and the environment, have experience in budgeting for activities in the locality, and can make decisions accordingly. Where multi-

stakeholder innovation platforms are embedded in local governance structures there is an opportunity to direct financial resources (or any other initiative) towards these same governance structures. Local governance structures can be part of multi-stakeholder innovation platforms, working in collaboration with the fora (i.e. mobile hubs) at different network levels, having facilitation, mentoring and monitoring of external stakeholders in the innovation process for a transparent and accountable use of resources. Most innovation platforms of the IAR4D approach were embedded or established in local governance structures. With decentralisation, local based governance structures have increased (in Uganda, for instance, at the district level, the SACCOS). These local governance structures work in many places in Africa, and there is an opportunity for external initiatives to grow there.

Financial management would also give more control to rural communities and empower them to demand services from a diversity of providers. When farmers are supported financially, with information to make informed decisions, they can also request the facilitation and mentoring of stakeholders external to the innovation platform. It is important to support and encourage a culture where farmers demand services, and are empowered to develop their capabilities and request the support that they need. External initiatives should not intervene without recognising local dynamics and problems, local knowledge and capabilities, and the local governance structures.

IAR4D is not the only approach that promotes platforms and there are currently many experiences with network approaches and platforms, although often with different names and terminologies. A multi-stakeholder platform with its ambidextrous management could be encountered in a multi-stakeholder cooperative, a Village Information and Communication Centre, a community of practice, a network of practice, a regional cluster, a public and private partnership, or an ICT mediated network.

Regarding the outcomes of innovation processes, this thesis shows that the management of structural challenges in networks was not the most important influence on performance. This contrasts with how ambidexterity has an important influence on the performance of large firms through balanced or combined units for exploration and exploitation. Mueller et al. (2013) envisaged networking as a way of balancing to manage exploration and exploitation. However, the results in Chapter 5 on network governance of agricultural innovation networks were not robust, indicating a weak effect on fostering capabilities to explore and exploit innovation opportunities. This suggests that networking is not sufficient to ensure ambidexterity in networks. Further research is recommended to test how an ambidextrous management (testing the interplay among structural, contextual and temporal challenges) can improve the governance capability and the performance of innovation networks. The cases studied in this thesis suggest that the context might determine to a greater extent the fostering of capabilities. The context might have a mediating effect. However, the ‘context’ requires a more multi-dimensional definition. In the case studies I encountered two main types of contextual boundaries, some were more fixed (e.g. geographical-spatial, national, local, regional, virtual), while others were institutional. The literature review in Chapter 2 found that the context and its challenges were related to various boundaries. Institutional boundaries like norms and sanctions were flexible, in the sense that they are socially constructed and they could be re-negotiated, however in practice these were the most constrictive to innovation. The context is no longer only a geographical space, but also the virtual space, the territory and even the network as the locus of social dynamics, and the institutional boundaries that frame social dynamics. The redefinition of the context is needed for measuring outcomes of the networks for more generalisable results. Further testing is therefore recommended to calculate the effect of the context as mediator between network governance and capabilities as indicators of performance-outcomes of the innovation process. This research would expose the interplay of structural challenges with contextual challenges over the innovation process, and which boundaries of the context are barriers or

enablers of innovation. It is recommended to identify more precise linkages between ambidexterity and other capabilities and the appropriateness/effectiveness of each capability or combined hybrid capabilities for managing exploration and exploitation, using the context as a control variable.

Further studies are also recommended to test ambidexterity as a capability of innovation networks tackling other types of global challenges at multiple levels in complex environments, in developed and developing countries. It is encouraged to observe mobile hubs managing interfaces (structural, contextual and temporal) for coordinating collective efforts in other types of multi-level network settings. The forms of partnerships and other business models that emerge for exploration and exploitation, and whether networks orchestrated in a combined manner, or with a lead organisation, might result in different performance and outcomes. Network capabilities (organisational, knowledge, technological, etc.) might differ when addressing other global challenges, in contexts with other boundaries, and with other stakeholders participating in the innovation process.

Summary

Tackling complex challenges in developing countries (e.g. poverty, food insecurity, climate change) requires a collective effort by a diversity of societal actors in innovation networks. Innovation networks include multiple levels of networks (families, teams, organisations, clusters, network levels, etc.), and allow collective efforts to explore and exploit innovation opportunities. The management of complex challenges in innovation networks entails a higher order capability called ambidexterity.

Ambidexterity is a concept that has been widely studied in the context of organisations, and is receiving increasing attention from scholars from various scientific domains because of its influence on the performance and outcomes of organisations. However, there are few studies on ambidexterity of innovation networks, which is the topic addressed in this thesis. Insights on ambidexterity of innovation networks are relevant for network management and thus for the coordination of multi-level innovation networks that tackle complex challenges. More specifically, important gaps in the literature on innovation management are the evolution of innovation networks, how innovation networks are governed to explore and exploit innovation opportunities, and how different network governance mechanisms influence the network capabilities. This thesis presents evidence of how ambidexterity is a higher order and collective managerial capability of innovation networks, and how it entails multiple capabilities that allow for simultaneous exploration and exploitation of innovation opportunities.

The first objective of this thesis is to understand the state of the art of the literature on ambidexterity in relation to innovation processes. Chapter 2 therefore consists of a systematic literature review on ambidexterity, addressing the following research questions:

-In which journals, settings and countries and on which units of analysis have studies on ambidexterity been conducted?

-What are the main themes and the emerging themes in studies on ambidexterity?

-What gaps are found in the literature of ambidexterity?

The review shows that the majority of studies of ambidexterity in innovation processes have concentrated on organisations in developed countries, with relatively few experiences in the global south.

The systematic review configures concepts that emerge from the literature to generate theory, following an inductive approach through an iterative analysis of concepts (Gough et al., 2012).

The review proposes that structural, temporal and contextual ‘solutions’ presented in the literature could be presented more adequately as ‘challenges’, given the complexity that managing exploration and exploitation represents in reality, and particularly in developing countries.

Ambidexterity is a higher order capability that is found to be related to multiple capabilities necessary for managing exploration and exploitation. The analysis of the literature indicates the need for multi-level and holistic approaches, looking at network capabilities associated with ambidexterity. The review identifies as a gap in the literature the lack of a theoretical framework on ambidexterity as a capability of innovation networks. This thesis addresses this gap by offering an overview of the main themes in the literature, and presents a more integrative perspective, proposing ambidexterity as a capability of multi-level innovation networks in innovation processes. In the open innovation paradigm, the insights from investigating ambidexterity as a collective capability are fundamental to understand how networks can explore and exploit innovation opportunities by taking advantage of the synergies among network actors. This chapter then proposes a network capability perspective for the assessment of the performance and outcomes of innovation processes.

Chapter 3 addresses a major gap in the literature and focuses on how network actors tackle collectively some complex developmental challenges in developing countries, i.e. rural food security and poverty. The chapter addresses the following research question: *What roles are played and by whom to foster ambidexterity in netchains for tackling challenges faced by smallholder farmers in Sub-Saharan African countries?*

This chapter identifies specific roles played by stakeholders to foster exploration and exploitation in innovation processes. These roles refer to different types of contradictory activities: (i) simultaneous coordination of different network levels; (ii) managing informal and formal organisational relationships; (iii) inviting new members and opening the network for novelty and change, while also consolidating the network for stability; (iv) negotiating different interests of stakeholders; (v) managing the timing of different simultaneous activities in the innovation process, and; (vi) fostering stability and flux of the process. The roles of stakeholders are important in the creation of innovation network capabilities to evolve into business networks and collective entrepreneurship.

The case study method is used in this and the following chapter. Data collection was divided into two phases in order to capture changes of stakeholders, roles and coordination mechanisms over time when facing complex challenges common in developing countries. Semi-structured interviews, observations and focus group discussions were conducted with key informants including farmer members of producer organisations, service providers, researchers, managers and other -stakeholders of potato netchains in Uganda, Rwanda and the Democratic Republic of the Congo. A participatory mapping of the evolution of innovation networks was used for tracking the evolution of multi-level innovation networks of different innovation process trajectories using the event mapping schema of Van de Ven et al. (2008). The analytical tools of netchain analysis (Lazzarini et al., 2001), were adjusted for tracking organisational relationships and inter-dependencies. These organisational relationships represent different configurations of innovation networks (involving certain layers of the netchain), ways of integration (horizontal, vertical, cross-integration) and types of relationships (formal or informal for exploration and/or exploitation), which are used as indicators of governance mechanisms and changes of partnerships along the innovation process.

The results indicate the importance of the management design for the orchestration of innovation networks. Diverse stakeholders need to work in collaboration to tackle challenges in complex

settings like netchains. Collective roles take advantage of synergies among actors, are important for tackling challenges, and are a source of value addition in innovation processes. Structural, contextual and temporal mobility are crucial for more dynamism in innovation processes, particularly in platforms that allow the emergence of mobile hubs that function as interfaces of multi-level networks. There are still likely to be some missing stakeholders whose roles are vital for tackling complex challenges like power and gender imbalances, and other asymmetries, but public and private partnerships like Multi Stakeholder Innovation Platforms are vehicles to engage multi-stakeholder and multi-level networks.

Chapter 4 addresses the research question: *How are innovation networks that cooperate with smallholder farmers coordinated to balance exploration and exploitation when tackling collective challenges in an innovation process, and through which governance mechanisms?*

This chapter contributes empirical evidence on how ambidexterity evolves in practice in complex settings. It takes a longitudinal approach for tracking innovation networks that aim to tackle complex problems of smallholder farmers in Sub-Saharan Africa. It presents six case studies on innovation networks in developing country settings, thus responding to the imbalance of studies that have historically been concentrated in developed countries.

This chapter presents empirical evidence on governance mechanisms of innovation networks and emergent business models to foster simultaneously multiple network capabilities. Multi-stakeholder innovation platforms are a multipurpose type of cooperative for simultaneously tackling various challenges. These platforms use a combination of formal and informal network governance mechanisms to manage the resources of the multi-stakeholder networks at different network levels and stages of the innovation process. The platforms provided a ‘safe space’ for the emergence of mobile hubs of innovation networks, which serve as interfaces for orchestrating multi-level networks and fostering multiple capabilities to explore and exploit innovation opportunities.

Chapter 5 proposes a network capability perspective for the assessment of the performance and outcomes of innovation processes. It contributes a longitudinal perspective to see how ambidexterity takes place in practice with the evolution of innovation network capabilities, and fills in the gap of longitudinal studies on ambidexterity. Results are important for network management in innovation processes of multi-level networks tackling global challenges.

In the context of rural development, there are a large number of interventions that help family farms tackle challenges like food insecurity and poverty. However, most studies of these interventions have concentrated on the performance of organisations and on explaining the implementation of already-developed technologies. Very few intervention impact assessments have analysed the performance of networks using a longitudinal approach, tracking the evolution of network capabilities as indicators of outcomes of an innovation process. Consequently, the fifth chapter tests how innovation networks can help family farms through fostering network capabilities, and how the synergies among actors have an effect on the outcomes of innovation processes. The research question addressed in chapter 5 is: *What network governance mechanism of innovation networks best enable family farms in developing countries to foster capabilities for exploring and exploiting innovation opportunities?*

Three governance mechanisms of agricultural innovation networks for exploring and exploiting innovation opportunities are tested using household-level panel data from Uganda, the Democratic Republic of the Congo and Rwanda. The panel data comprises 2,562 households from the six same cases investigated in Chapters 3 and 4, as well as from other agricultural netchains in neighbouring locations.

The different governance mechanisms enable innovation networks to foster family farms' capabilities for exploring and/or exploiting innovation opportunities. Results indicate that first-order governed networks foster capabilities for exploitation as well as exploration, while second-order governed networks foster some specialised capabilities for exploitation. Meta-governed innovation networks are most effective in combining multiple capabilities for exploration and

exploitation. However, the results indicate that the relationship between network governance and ambidexterity of innovation networks is not robust.

The management of structural challenges for ambidexterity, through combined or separated work units, is a key factor in the outcomes and performance of organisations. However, chapter 5 shows that fostering ambidexterity via different network governance mechanisms that focus mainly on managing structural challenges is not the most effective managerial strategy. Fostering ambidexterity in multi-level network settings by focusing mainly on networking as a way of balancing exploration and exploitation (Mueller et al., 2013) is not sufficient. Managing exploration and exploitation effectively might need a more ambidextrous management of structural, contextual and temporal challenges, which would require the network to have ‘govern-ability’ and sufficient resources.

More research on the context as a mediating factor between network governance and capabilities is recommended, considering that the ‘context’ is a multidimensional concept that needs to be redefined. This is a key consideration for network management in settings of increasingly international multi-level innovation networks that collectively tackle different types of global challenges.

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Completed Training and Supervision Plan



Wageningen School
of Social Sciences

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Rural Institutions and Economic Development, DEC 52306	WUR	2009	6
Cooperatives and Producer Organisations, BEC 53306	WUR	2013	6
Social Network Analysis	University of Southern Denmark	2013	5
Proposal Writing	WUR	2009	6
B) General research related competences			
CERES Orientation programme	CERES, Utrecht	2009	5
Quantitative Data Analysis: Multivariate Techniques, YRM 60306	WUR	2013	2
From Topic to proposal	WASS	2009	4
Scientific Integrity	WGS	2013	0.2
Systematic Literature Review	WASS	2013	3.7
Quantitative Research Methodology and Statistics, MAT 22306	WUR	2014	3
C) Career related competences/personal development			
CERES presentation tutorials	CERES, Utrecht	2009	5.5
Scientific Publishing Workshop	WGS	2013	0.3
Atlas-ti Workshop	WASS	2013	1
<i>Village Information and Communication Centres in Rwanda</i>	Innovation Africa Symposium	2008	1
<i>Innovation brokers and their roles in value chain-network innovation: preliminary findings and a research agenda</i>	Innovation & sustainable development in agriculture and food, France	2010	1
<i>'Tracking the social organisation of innovation: Tracking Mobile Hubs of innovation networks tackling societal challenges'</i>	Sub-Saharan Africa Challenge Program, Rwanda	2010	1
<i>'Dynamic evolution of innovation networks and the roles of innovation intermediaries in agricultural netchains: Potato netchains in Rwanda, Uganda and Democratic Republic of the Congo'</i>	Challenges and opportunities for agricultural intensification of the humid highland systems of sub-Saharan Africa, Rwanda	2011	1
<i>'Ambidextrous management in potato netchains in Sub-Saharan and Central Africa: Mobiles hubs of innovation networks and their dynamic meta-governance in multi-stakeholder innovation platforms for tackling societal challenges'</i>	IFAMA, South Africa	2014	1
Total			52.7

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

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