Murat Sartas

Do multi-stakeholder platforms work?

Contributions of multi-stakeholder platforms to the performance of research for development interventions

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Do multi-stakeholder platforms work?

Contributions of multi-stakeholder platforms to the performance of research for development interventions

Murat Sartas

Thesis
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For Denis Muratovic Sartas

Murat Sartas
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Preface and acknowledgements

This PhD research was more than an academic endeavor; rather, it was a fully-fledged learning puzzle to which many people contributed a piece. It is very difficult to thank each person for the pieces they provided, but I would like to acknowledge a few individuals who contributed cornerstones of the puzzle that not only enhanced the puzzle but also guided the addition of other important pieces.

The first such person who made a significant contribution is Dr. Linley Chiwona Karltun. She opened the door for me to delve into research on livelihoods, introduced me to Africa in 2011, and facilitated my first research position in the Swedish University of Agricultural Sciences in Uppsala. I thank Dr. Linley Chiwona Karltun for the major inspiration she provided and her creativity for me to sustain the work in tough times. During my research assistance work in Uppsala in late 2013, I participated in a conference. There, a senior researcher Dr. Piet van Asten, endured my endless questions during the coffee breaks. I would like to thank him for his patient listening to my critical inquiries at the conference, for his following up our conversations with an invitation for a workshop in DR Congo in early 2014, and for his channeling my curiosity into the project on which I conducted my PhD research. Without Dr. Piet van Asten's brokering, this research would not have been possible.

The workshop I attended in 2014 charmed me into a series of other events, and I ended up working as a researcher in the International Institute of Tropical Agriculture (IITA) and starting my PhD research in Wageningen University. Until this series of events, I never thought that a PhD had a significant value for having a real impact on livelihoods. Although I worked as a research assistant for more than two years, I did not think that pursuing a PhD was a promising idea. It was Prof. Cees Leeuwis who showed me the possibility of doing impactful research and Dr. Marc Schut whose energy and applied science interest convinced me that a PhD can be a crucial step to have a visible impact on livelihoods. Among all the other major contributions they made to my puzzle, I would like to thank Prof. Dr. Cees Leeuwis and Dr. Marc Schut for being wonderful examples of scientists who can have an impact on livelihoods.

During the four years of my PhD research, not everything was smooth and positive. I had a few major shocks that significantly reduced my morale and enthusiasm to do research. In these challenging times, Dr. Marc Schut and Thomas Norrby tolerated my retreat from work and life, provided me with an environment that I could use to come back to the research. I express my deepest gratitude to Dr. Marc Schut and Thomas Norrby, whom I always remember as the people who stood with me in the most diffi-

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Murat Sartas

Didim, 10 July 2018

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General Introduction

1.1 Introduction

This thesis investigates the contribution of multi-stakeholder platforms (MSPs) to the performance of interventions conducted by research organizations aiming to improve innovation and livelihood systems. Such interventions are often labelled as Research for Development (R4D) interventions. The thesis builds upon 10 MSPs implemented in Burundi, DR Congo, Rwanda, and Uganda between 2013 and 2017.

This first chapter provides a general introduction and background to the thesis. It briefly describes the rationale for the study, explains the theories and the key concepts applied in the thesis, and discusses the research approach for studying the contribution of MSPs to R4D interventions. Then, it states the research objectives and the research questions and introduces the research method used. The chapter concludes with a general outline of the thesis and describes each chapter and its contribution to the thesis.

1.2 Why study the contribution of MSPs to R4D interventions?

Using MSPs is a popular approach to organizing R4D interventions (hereafter referred to interchangeably as interventions) (Klerkx et al., 2012; Van Paassen et al., 2014; Kaiser et al., 2016; Sartas et al., 2017), especially in low- and middle-income countries (Norman, 2002; Schut et al., 2016b). MSPs are used across different domains that affect livelihoods such as natural resource management (Faysse, 2006; Warner, 2006a), sustainable intensification (Schut et al., 2016c), environmental management (Kaiser et al., 2016), disaster management (Djalante, 2012), and health services (Vassal et al., 2015; McHugh et al., 2016). Moreover, they are applied as part of different intervention types such as policies (Hale and Mauzerall, 2004; Rothenberger et al., 2005; Kefasi et al., 2011; Beers and Geerling-Eiff, 2014), programs (Adekunle and Fatunbi, 2012; Kozica et al., 2016), and projects (Kilelu et al., 2013; Kaiser et al., 2016), which are further discussed in the following section.

However, MSPs are not only argued to make positive contributions to interventions (Norman, 2002; Hall and Clark, 2010; McHugh et al., 2016), but also considered to be applied effectively in different circumstances (Joy et al., 2008; Kefasi et al., 2011; Adekunle and Fatunbi, 2012; Akpo et al., 2014). MSPs have also failed (Faysse, 2006; Warner, 2006a), and several authors have warned that MSPs should not be seen as a panacea to make R4D interventions contribute to livelihood improvement (Faysse, 2006; Warner, 2007; Schut et al. 2016a; Hermans et al., 2017). The different experiences with MSPs, as well as their performance, suggest that the contribution of MSPs to R4D interventions depends on a broad range of factors (Sartas et al., 2017).

The R4D literature suggests three major factors – locational, intervention-related, and temporal – that influence the contribution of MSPs to interventions. In addition, each major factor has various specific elements. To capture the influence of the diversity of factors that can potentially influence the contribution of MSPs to interventions, a study has to be comprehensive and systematic and must consider the dynamic nature of some factors.

However, the current R4D literature does not provide a comprehensive, systematic, and dynamic study, and neither does it cover the variety of methodological strategies needed to investigate such diverse contents. Many of the studies investigating the contribution of MSPs to intervention performance are partial in terms of their coverage and methods. Quantitative studies have compared pre- and post-intervention data (Pamuk et al., 2014) and demonstrated both positive and negative contributions (Martey et al., 2014; Pamuk et al., 2014; Mango et al., 2017). However, they do not report on specific factors that contributed to that proclaimed positive or negative influence. Qualitative studies have typically offered information on the specific factors that influence MSPs. However, they focus on only a few cases and do not sufficiently report on confounding factors (Backstrand, 2006; Mallett et al., 2012; Badibanga et al., 2013). For instance, studies focusing on facilitation, negotiation, and conflict resolution hardly report on different aspects of intervention, e.g. the available funding. Moreover, in terms of studying the dynamic nature of factors influencing MSPs, existing R4D studies do not go beyond highlighting the need to understand and study the dynamic aspects that influence the contribution of MSPs to interventions (Alsop and Farrington, 1998; Sanginga et al., 2007; Neef and Neubert, 2011; Kilelu et al., 2013; Eriksson et al., 2014; Dickson-Gomez et al., 2016). Neither do they use the diverse methodologies required to investigate such factors.

This thesis aims to fill this gap by investigating the contributions of MSPs to interventions in a comprehensive, systematic, and dynamic way using multiple qualitative and quantitative research methods.

1.3 Conceptual orientation of the thesis

Two central concepts in this study, interventions and MSPs, are defined in multiple ways in the literature. Therefore, we specify the context and understanding of the central concepts as utilized throughout the thesis. We also investigate the literature to better understand the relation between MSPs and the performance of R4D interventions.

1.3.1 Research for development interventions

R4D interventions are research initiatives aiming to improve innovation and livelihood systems. Typically, they focus on (i) prioritizing, (ii) generating, (iii) disseminating, and (iv) increasing the use of innovations in the areas they target. Each intervention might focus on either one of these activities or a combination of them. In prioritizing, interventions often assess existing livelihood problems and identify innovations that can contribute to the solution of these problems. As many innovations can contribute to solutions, interventions prioritize them and focus on a selected few. In generating, interventions develop innovations from scratch or adapt them from another geographical area. In disseminating, interventions focus on making innovations available at scale. They develop distribution and support systems that connect an innovation to end users. Finally, interventions aim to increase the use of innovations at scale. They increase the awareness and capacities of innovation end users.

Although it is difficult to draw clear boundaries for interventions, R4D interventions can be distinguished from other types of interventions through commonly recurring features. First of all, in R4D interventions, research plays a central role to which a significant level of resources are allocated (Delisle et al., 2005; Laws et al., 2013). Second, they often consider multiple livelihood aspects where multiple and interrelated intervention objectives and components are pursued, and where the synergies and trade-offs between them are explicitly considered (Abate et al., 2011; Ashby, 2003; Delisle et al., 2005). Third, because innovation processes are complex and the actors in these systems are diverse, R4D interventions include participatory approaches (Abate et al., 2011; Davis and Whittington, 1998; Laws et al., 2013; Schut et al., 2016b) and multi-disciplinary teams (Ashby, 2003; Laws et al., 2013; Nuyens, 2007; Rosenfield, 1992).

Currently, the majority of interventions are formulated as policies, programs, or projects (Laws et al., 2013). R4D policy interventions aim to develop legislative and non-legislative policy strategies for targeting multiple livelihood aspects. R4D projects are typically 2–4-year interventions consisting of a combination of different activities that contribute to several ex-ante defined objectives. R4D programs often consist of multiple R4D projects where each project contributes to the overall program objective.

R4D policy interventions were first implemented by some of the organizations under the UN in the early 1970s (Sagasti, 1989). They were implemented in different policy domains including education and culture (UNESCO), economy and trade (UNCTAD), industrial development (UNIDO), and human resources (ILO). Since then, they have also been implemented by other intergovernmental and international non-governmental organizations (IGOs and INGOs) and international development agencies

across the globe. The domains in which they are implemented include all major policy domains such as public health (Eriksson et al., 2014; Greenhalgh and Fahy, 2015; Zinsstag et al., 2011), natural resource management (Bosch et al., 2007; Giller et al., 2008), agricultural development (Amerasinghe et al., 2013; deZeeuw, 2010), and environmental management (Akhtar-Schuster et al., 2011; Cook, 2008). Nowadays, R4D policy initiatives are implemented by a broad range of agencies.

International development agencies of high-income countries, the World Bank, the International Fund for Agricultural Development (IFAD), and the Consortium for Global International Agricultural Research (CGIAR) provide the bulk of financial investments in R4D programs and projects in the agricultural sector. Health sector interventions have been supported by WHO, the UK Department for International Development (DFID), and the Swiss Agency for Development and Cooperation (SDC). In natural resource management and environmental management, CGIAR and its donors are the main investors currently.

1.3.2 Multi-stakeholder platforms

MSPs are defined as decision-making bodies (Steins and Edwards, 1999) or roundtables where a diversity of stakeholders (Warner, 2006a) get together to get things done (Röling and Woodhill, 2001a). In the R4D context, MSPs often lead to a series of different events that are organized across intervention implementation, in which research and non-research stakeholders are actively involved in the design and management of research endeavors, including analysis of problems, prioritization of innovations to overcome these problems, choosing geographical locations in which to work, and participatory monitoring and evaluation.

In the R4D literature, MSPs are 'branded' in multiple ways. Some recent examples include public–private partnerships (Abbott, 2012; Eggersdorfer and Bird, 2016; Hall, 2006; Reypens et al., 2016; Spielman et al., 2010; Yildirim et al., 2016), innovation platforms (Dror et al., 2015; Hermans et al., 2017; Sanyang et al., 2015; Schut et al., 2016b; Tenywa et al., 2012), sustainability platforms (Kachel and Jennings, 2010; Munoz-Erickson and Cutts, 2016; Zuurbier, 2010), multi-stakeholder partnerships (Kefasi et al., 2011; Backstrand, 2006), or simply multi-stakeholder platforms (Adekunle and Fatunbi, 2012; Djalante, 2012; Hermans et al., 2017; Thiele et al., 2011; Warner, 2006a). Although the names differ, all of them include mechanisms for researcher and non-researcher stakeholders to engage in the collective efforts of problem solving and decision making on a regular basis during the intervention.

1.3.3 Multi-stakeholder platforms to enhance the performance of R4D interventions at diverse interfaces, a generic impact pathway

MSP implementation triggers a continuous change context in which interventions take place, and this may lead to changes in broader innovation and livelihood systems. Although change happens continuously, the R4D literature frequently refers to five specific interfaces where the influence of MSPs on interventions can be observed. I call them interfaces of change. For instance, MSPs can trigger change in some multi-stakeholder processes, e.g. increased participation or shared understanding, that drive changes in the overall configuration of multi-stakeholder actors in a system, e.g. collaboration or knowledge exchange. From here onwards, I refer to the processes that drive the changes in the multi-stakeholder actor configuration as process drivers and the associated changes to which such actor configuration may lead as process outputs (Table 1-1). Process outputs are typically accompanied by products such as research publications. All the intervention outputs combined are expected to lead to livelihood outcomes, e.g. increased access to vaccination, which can lead to livelihood impact, such as improved public health. Therefore, the influence of MSPs on R4D intervention performance can be conceptually modelled as a causal chain of five interfaces of change that form a potential impact pathway for MSPs in intervention contexts (Figure 1-1).

Figure 1-1. Generic R4D impact pathway, MSP contributions, indicator specificity, and observability duration of the interfaces of change I have moved this up. Caps for first only; Livelihood outcomes?

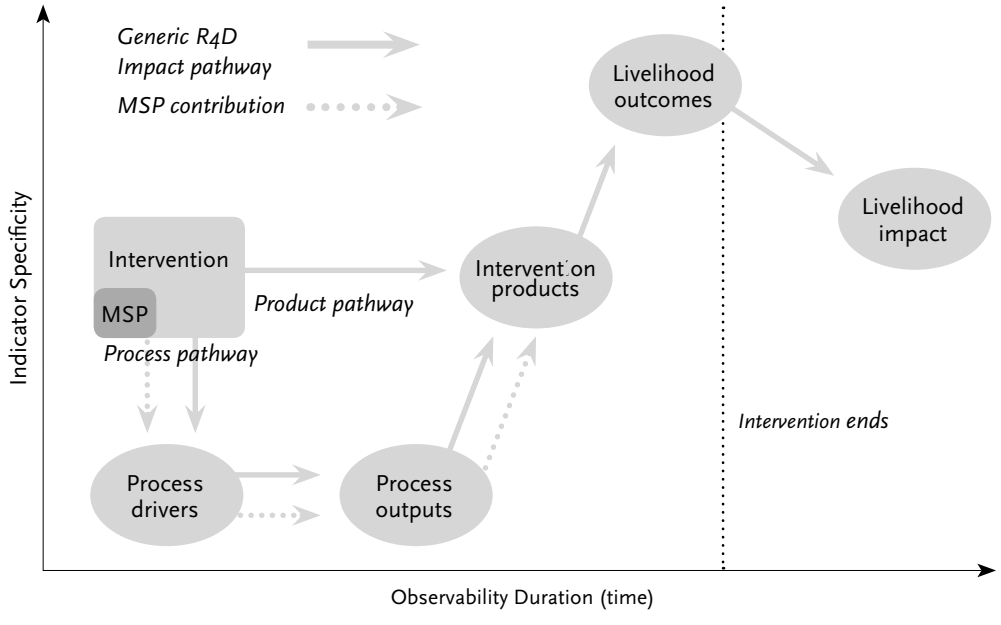


Table 1-1. Changes triggered by MSPs in R4D intervention contexts Size reduced to improve readability.

Change interface	Examples	Indicator specificity	Observed time	Sample references
Process drivers	Participation, shared understanding, engagement, learning	Generic	During the intervention	Aw-Hassan (2008); Hale and Mauzerall (2004); Home and Rump (2015); Leeuwis (2000)
Process outputs	Increased collaboration, improved knowledge exchange	Generic	During the intervention	Alsop and Farrington (1998); Fazey et al. (2014); Head (2008); Hermans et al. (2015); Kaiser et al. (2016)
Intervention outputs	Contracts, policy documents, technologies	Selected by the intervention	During or at the end of the intervention	Amerasinghe et al. (2013); Delisle et al. (2005); Eriksson et al. (2014); Hall et al. (2000)
Livelihood outcomes	Increased income, access to vaccination, access to finance	Selected by the intervention	At the end of the intervention or longer	Blignault et al. (2015); Brooks et al. (2013); Eriksson et al. (2014); Opondo et al. (2003); Zornes et al. (2016)
Livelihood impact	Poverty reduction, improved public health, reduced carbon emissions	Generic	Beyond the intervention lifespan	Hall et al. (2003); Kaaria et al. (2005); Stuer et al. (2009); Zornes et al. (2016)

The process drivers presented in Table 1-1 constitute the first interface that influences interventions, and interventions attempt to enhance them in order to achieve their objectives. For instance, R4D interventions typically aim to increase overall stakeholder participation in intervention activities or the participation of specific stakeholder groups such as youth, women, or the private sector in order to achieve their objectives.

Process drivers can be observed during the intervention. It is possible to monitor how many participants are attending and how much influence they have in the activities. It is also possible to use generic indicators to study process drivers. For example, it does not matter whether an intervention is a program or a project, or whether it focuses on

health or agricultural objectives, participation can be studied in the same generic way. Process outputs are the changes in the process-related configurations of the multi-stakeholder actors, such as collaboration and knowledge exchange. They can be observed during the intervention. For instance, the number of actors with whom other actors collaborate, or the subject of the collaboration, can be studied by asking simple questions during different intervention activities. Moreover, they can be studied by using generic indicators, such as the number of other stakeholders with whom a stakeholder is collaborating or whether the function of the collaboration is to exchange knowledge or to access funds. Intervention stakeholders collaborate in both policy and project-type interventions. Therefore, the number of stakeholders or the function of the collaboration can be used in both types of intervention.

Intervention outputs are tangible and, similar to process outputs, can be observed during the intervention lifespan. However, they are contextual and defined by the intervention. Collaboration and knowledge exchange among the participants in an intervention might lead to patents, research publications, or policy documents depending on the objectives of the intervention and the targeted context.

Livelihood outcomes of an intervention are the result of the process outputs and the intervention outputs, and livelihood impact is the trigger. For instance, a new policy (product) and increased collaboration between stakeholders (process) can lead to increased income, which then is the livelihood outcome. Livelihood outcomes are usually context specific and therefore defined by the intervention. The new policy and increased collaboration can be used to increase income or improve hygiene depending on the priorities set under the intervention. Although they might be observed during an intervention, they can also be absent until after the intervention.

Livelihood impact refers to the endgame of an intervention. Some examples of impacts are poverty reduction, increasing employment, improving public health, decreasing carbon emissions. Impact is studied by investigating the changes in livelihood systems and is usually defined by standard frameworks such as the United Nations' Millennium Development Goals (MDGs) – more recently Sustainable Development Goals (SDGs). Impacts happen over a long-term period (Douthwaite et al., 2003; Johnson et al., 2003; Martin et al., 2013; Stuer et al., 2009), often after intervention implementation.

At the five interfaces of change, process outputs and process drivers can be studied using generic indicators. In other words, understanding them better can provide information on the performance of diverse types of interventions, e.g. policies, programs, or projects in domains such as agriculture, health, environmental management.

Moreover, they can be observed during the implementation phase of interventions (Figure 1-1). Thus, studying them can provide inputs for the adaptive management of interventions. Therefore, for the thesis, I chose to focus on process outputs and process drivers to investigate the contributions of MSPs to intervention performance.

1.4 Empirical orientation of the thesis

Interventions with MSPs have been used in various domains that affect livelihoods, such as health and agricultural and environmental management. However, an empirical study that examines contributions of MSPs to interventions across these domains requires financial resources beyond those available for this thesis. Therefore, a single R4D program provides the empirical context for the thesis. This section provides the rationale for selecting the empirical cases and contextualizes the selected cases.

1.4.1 Rationale for choosing the empirical cases

Agriculture is one of the domains in which MSPs are frequently used to organize interventions (Schut et al., 2016b). In all research intervention types described in section 1.3.1, i.e. policy interventions, programs, and projects, MSPs have been used, and multiple studies focus on these interventions. In addition, most of the MSP brands described in section 1.3.2, such as innovation platforms, public–private partnerships, have been applied in the agricultural sector. In other words, interventions in agriculture cover a large variety of R4D types and MSPs. Consequently, the agricultural sector offers an excellent and rich context to study the contribution of MSPs to R4D interventions (see Table 1-2).

1.4.2 Empirical research context

The thesis investigates an R4D program called the CGIAR Research Program for Integrated Systems for Humid Tropics (henceforth referred to as Humidtropics). Humidtropics, implemented between 2013 and 2017, was primarily concerned with improving agriculture-based livelihoods. It included various regions, one of which was East and Central Africa, which included (but was not limited to) Burundi, Eastern Democratic Republic of Congo (DR Congo/DRC), Rwanda, and Uganda. It targeted multiple livelihood impacts including reducing rural poverty, increasing food security, improving nutrition and health, strengthening the sustainable management of natural resources, and improving capacity to innovate. To achieve this, Humidtropics focused on the following livelihood outcomes: improving agricultural productivity, access to affordable food, consumption of nutritious foods, decreasing environmental harm from agriculture, and improving local innovation systems' capacity to innovate (CGIAR, 2012). The thesis studied 10 MSPs operationalized in Burundi (2), DR Congo

Table 1-2. Examples of agricultural interventions classified by intervention type and different MSP brands.

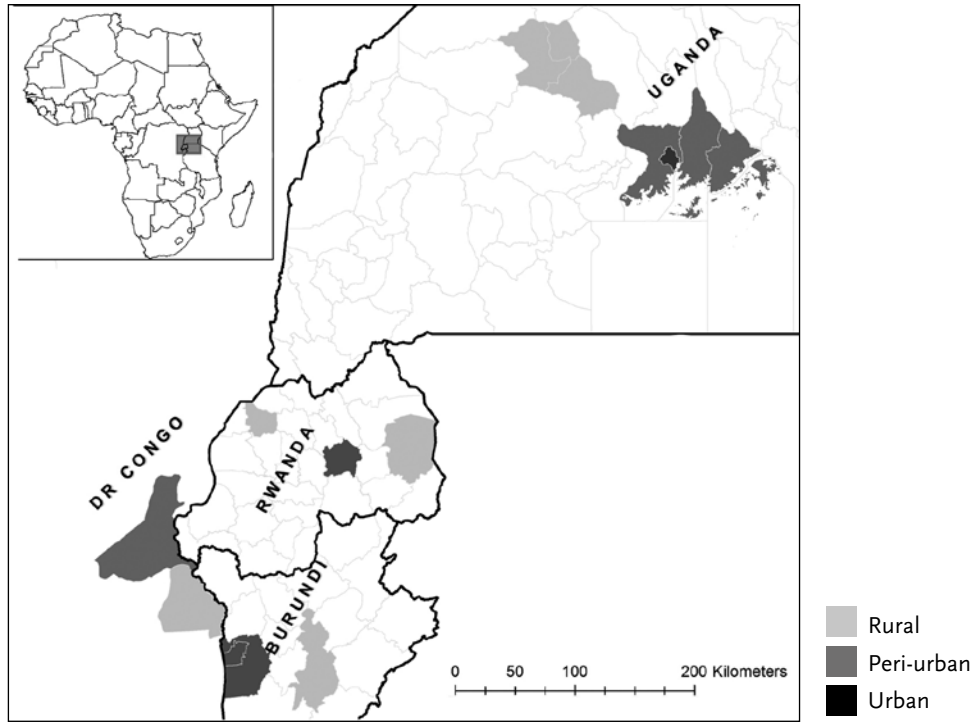
Intervention type	Policy	Program	Project	Other
MSP brand				
Innovation platforms	Adekunle and Fatunbi (2012); Kilelu et al. (2013); Nederlof et al. (2011)	Kilelu et al. (2013); Pamuk et al. (2014); Schut et al. (2016b,c); Tenywa et al. (2012)	Adekunle and Fatunbi (2012); Klerkx et al. (2013); Nederlof et al. (2011); Schut et al. (2016a); Tenywa et al. (2012)	Nederlof et al. (2011); Tittonell et al. (2012)
Multi-stakeholder platform	Adekunle and Fatunbi (2012); Haemaelaeinen et al. (2001); Leeuwis (2000); Röling (1994)	Alsop and Farrington (1998); Leeuwis (2000); Steins and Edwards (1999)	Adekunle and Fatunbi (2012); Verhagen et al. (2008)	Adekunle and Fatunbi (2012); Leeuwis (2000)
Private–public partnerships	Ferroni and Castle (2011); Narrod et al. (2009); Poulton and Macartney (2012); Spielman et al. (2010)	Abbott (2012); Narrod et al. (2009) Poulton and Macartney (2012); Spielman et al. (2010)	Abbott (2012); Ferroni and Castle (2011; Poulton and Macartney (2012); Spielman et al. (2010)	Krishna and Qaim (2007); Swanson and Samy (2002)
Sustainability platforms	den Exter et al. (2015)	Eng (2012)	Kilian et al. (2013); Selfa et al. (2013)	Basiron (2007); Braga (2015); Zuurbier (2010)

(2), Rwanda (3), and Uganda (3) (Figure 1-2). The MSPs were implemented and supported through the Consortium for Improving Agricultural-based Livelihoods in Central Africa (CIALCA), an agricultural R4D project supported by the Belgian Directorate General for Development Cooperation and Humanitarian Aid (DGD).

1.5 Research objectives and questions

This thesis aims to contribute to the understanding of the contribution of MSPs to R4D intervention performance. In order to achieve this, the thesis formulated and studied the following research questions:

Figure 1-2. Map of the sites where Humidtropics and CIALCA operated.



- What are the initial characteristics of process outputs? How do they change following an R4D intervention with MSPs? Which factors trigger the changes?
- What are the initial characteristics of process drivers? How do they change following an R4D intervention with MSPs? Which factors trigger the changes?

1.6 Methodological approach

Investigating multiple factors that influence the contribution of MSPs to an intervention in a comprehensive, systematic, and dynamic way requires the effective implementation of different research methods. The thesis method should contain quantitative methods that can answer what/which MSP contributions as well as qualitative methods that can inform how the MSP contributions happened (Ragin, 2014; Bryman, 2006). In addition, as the intervention investigated by the thesis aims to address livelihood problems, it is desirable that the methods inform the actions of interventions, which is also referred to as action research. Therefore, the methodological approach of the thesis is based on a combination of qualitative, quantitative, and action research methods (Figure 1-3).

Figure 1-3. Methodological approach of the thesis.

Each chapter of the thesis focuses on and utilizes different methods and tools (Table 1-3). Chapter 2 describes in more detail the principles of the thesis methods, the data management approach, and the data management toolkits used in the thesis. In the thesis' empirical chapters (Chapters 3, 4, 5, 6), specific methodological details and approaches relating to the research questions or to the scope of the chapter are provided.

1.7 Thesis outline

The thesis consists of seven chapters (Figure 1-4). Following the General Introduction in Chapter 1, Chapter 2 introduces the data management approach and toolsets used to study the contributions of MSPs to interventions in a comprehensive, systematic, and dynamic way. Initially, it presents the principles of the data management system and the theory of change linking MSPs to interventions.

Chapter 3 responds to Research Question 1 and presents the first empirical study of the thesis. It explores the literature and identifies process outputs that were argued to have an influence on the contribution of MSPs. It (i) characterizes the initial status of process outputs using a social network approach, (ii) studies the configurations of

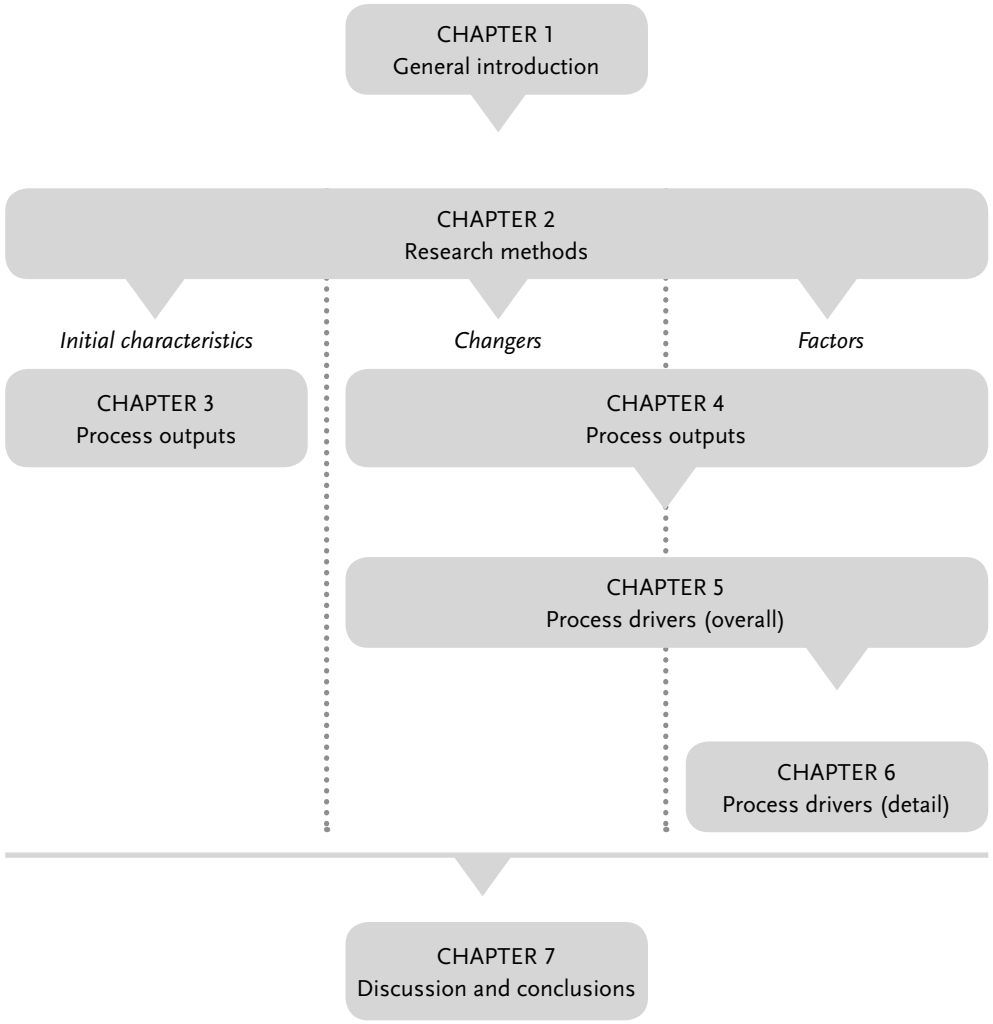
Table 1-3. Approaches and tools used in the thesis.

Effect	Chapter 3	Chapter 4	Chapter 5	Chapter 6
Chapter name	Social network analysis of multi-stakeholder platforms in agricultural research for development	Effects of multi-stakeholder platforms on multi-stakeholder innovation networks	Measuring the performance of multi-stakeholder platforms in research for development	Factors influencing participation dynamics in research for development interventions with multi-stakeholder platforms
Quantitative approaches	Social network analysis	Social network analysis, econometric analysis	Text analysis, trend analysis, descriptive statistics	Descriptive statistics, econometric models
Quantitative tools	Exponential random graph model, multiple choice survey questionnaire	Average degree, network modularity, logistic regression, correlation measures	Word frequency, customized thesaurus, correlation measures	Time series analysis
Qualitative approaches	Participatory observation	Participatory observation	Participatory observation, interviews	Participatory observation, interviews
Qualitative tools	Network maps, event logs	Network maps, event logs	Event logs, learning logs	Participant profile, event logs, interviews

networks representing process outputs, and (iii) compares and contrasts the existing configurations of the networks with ideal configurations described in the R4D literature. Chapter 3 shows that the configurations of the networks vary not only between the countries but also between different key processes. In other words, MSPs' contribution to R4D intervention performance might be context- and process specific.

Chapter 4 also responds to Research Question 1. Initially, using the theory of change explained in Chapter 2 and process outputs discussed in Chapter 3, it provides a conceptual foundation for explaining changes in network configurations. It explores the changes in the configurations of those stakeholder networks during the intervention and investigates the factors that influence the changes. It shows that MSPs do not necessarily enhance process outputs such as knowledge exchange or influence spread; on the contrary, they can hinder them. It also indicates that the initial configu-

Figure 1-4. Outline of the thesis.



ration of networks has more influence on the later configuration than the factors that can be influenced by the intervention, except for funding provided to the R4D events, i.e. existing connections can be unchanged by the intervention activities.

Chapter 5 responds to Research Question 2. It explores how changes in process drivers (Table 1-1) lead to the process outputs discussed in Chapters 3 and 4 when an intervention is organized through MSPs. It analyzes the relation between the changes in the process drivers and locational, temporal, and intervention-related factors in four countries: Burundi, DR Congo, Rwanda, and Uganda. Initially, building upon the

discussions in section 1.2, it conceptualizes the influence of MSPs on interventions as a continuum as opposed to a snapshot influence. Subsequently, it shows how these performance drivers change throughout the intervention and how locational, temporal, and intervention-related factors influence the observed changes in process drivers.

Chapter 6 presents the last empirical study in the thesis and further deepens Research Question 2 in relation to one specific process driver, i.e. participation. It investigates participation and various locational, temporal, and intervention-related factors that influence participation in one of the study areas, Uganda. Specifically, it reviews the literature and formulates two temporal factors: innovation focus and innovation development phase. Then, it explains how participation changed and which specific locational, intervention, and temporal factors influenced the changes in participation. Chapter 6 shows that a process driver might not change in average terms but might fluctuate substantially. It also indicates that factors influenced by interventions (e.g. human resources, funding) might have a smaller influence on the dynamics of a process driver than the factors that cannot be influenced within the scope of interventions (e.g. position of the target area on urban–rural gradient).

Chapter 7 provides the overall synthesis and discussion of the main findings of the thesis on the research questions. It then draws final conclusions and presents recommendations for using an MSP approach to implement R4D interventions. It also shares some of my experiences in conducting the thesis research and my reflections on them; this is intended to help researchers focusing on the same content as this thesis.

2

Learning System for Agricultural Research for Development (LESARD)

Published as a book chapter in *Sustainable Intensification of Smallholder Agriculture*: Sartas, M., Schut, M., Leeuwis, C., Oeborn, I., Vanlauwe, B., Atta-Krah, K., Thomas, R., Phillips, M., Schut, M. (Eds.). (2017). Learning System for Agricultural Research for Development Interventions (LESARD) - Effective Documenting, Reporting and Analysis of Performance Factors in Multi-stakeholder Processes Integrated Systems Research for Sustainable Intensification of Smallholder Agriculture, Earthscan, 367–380.

Abstract

The utilization of systems approaches using multi-stakeholder platforms as the mode of intervention has been increasingly experimented with in agricultural research for development. Recent research findings from so-called development countries indicate convincing evidence of the positive contribution of these multi-stakeholder platforms (for example through innovation platforms) to increasing the impact of research for development interventions. However, the available evidence on success factors of such processes is often based on qualitative case studies which are very contextual, whereas more generic lessons are hardly available. Quantitative assessment is based mainly on comparing pre- and post-intervention data sets. Although these identify whether interventions have made a significant impact, they fail to indicate sufficient evidence on the specifics of the intervention and their impacts on the process.

This chapter describes the development, testing, and implementation of a new documentation and learning system for multi-stakeholder platforms in agricultural research for development (LESARD) that is required for the purposes of this thesis, i.e. a comprehensive, systematic methodology that considers the dynamic aspects of processes and process drivers using a combination of the qualitative, quantitative and action research methods presented in Figure 1-3. It argues for a contextualized learning system based on an integrated approach to documentation, reporting, and analyzing the multi-stakeholder process. The system uses participatory, short-time loop, simple and cheap documentation, and reporting tools to capture the dynamics of processes and drivers. The chapter also sets the foundation for the detailed method discussions included in Chapters 3–6.

2.1 Introduction

This chapter aims to describe the foundations of the methodological approach used in this thesis. It provides the rationale for the need to develop a novel approach to enhance research and learning on interventions with multi-stakeholder platforms (MSPs) and describes the development process of the novel approach as well as its the components. It ends by listing and describing performance criteria for studying the contributions of MSPs to interventions in a comprehensive, systematic way that also considers dynamic aspects.

MSPs, where a set of interdependent stakeholders interact and organize activities to achieve a set of goals and targets collectively, have been implemented within research for development (R4D) interventions, for a few decades. Some recent examples of MSPs in this context are innovation platforms, learning alliances, and participatory value chain development processes. Moreover, MSPs have been increasingly used to implement so-called systems interventions (Klerkx et al., 2012; Schut et al., 2016b). Recent research findings from low- and middle-income countries indicate that MSPs increase the impact of interventions. However, either these studies apply a black box approach, i.e. do not say how MSPs contributed to the interventions (Bloom, 2010) or their results are hardly generalizable (Hall et al., 2001).

Quantitative assessments focusing on the contribution of MSPs are based mainly on comparing pre- and post-intervention data (Duflo et al., 2014; Pamuk et al., 2014). Although these identify whether MSPs have made a significant contribution, they fail to provide sufficient evidence on the factors that influence the process outputs and process drivers. Qualitative assessments do offer information on specific elements of the intervention. These provide insight into the key factors that influence the contribution of MSPs to R4D interventions, such as leadership commitment (Anandajayasekeram, 2011). However, qualitative assessments do not sufficiently report on contextual factors such as proximity to markets and speed of population growth, and their results are considered insufficient in providing evidence for decision making in other contexts (Spielman et al., 2009).

Most system interventions such as the CGIAR Research Program on Integrated Systems for the Humid Tropics (Humidtropics) use two interwoven principles: a systems approach and MSPs (CGIAR, 2012). One of the principles of systems approaches to R4D is to optimize the achievement of multiple livelihood outcomes. For instance, in addition to the conventional objectives of improving yields, incomes, and environmental services, Humidtropics targets nutrition, capacity to innovate, and gender empowerment. In Humidtropics, the MSP brands (see section 1.3.2) are innovation

platforms (operating at local, community level) and R4D platforms (operating at higher – often regional or national – systems levels). MSPs play a vital role in the identification of, experimenting with, learning from, and scaling R4D innovations.

LESARD is an action-oriented data management and decision-making support system for interventions in which MSPs are important components. It has two major objectives. First, it attempts to measure the contribution of MSPs and provide generalizable evidence of the factors that influence MSPs' contribution. It focuses primarily on process outputs and dynamic process drivers. It follows an integrated data collection and analysis method approach and attempts to discover what works in R4D. Second, it aims to improve the effectiveness and functioning of MSPs by providing information for adaptive management of interventions. For example, LESARD regularly provides information on the convergence of perspectives of different stakeholders and periodically reports on the contributions of specific R4D activities such as agronomic trials to the overall anticipated process drivers and outcomes. By combining research and development aspects of R4D, LESARD aims to contribute to the evidence base on MSP design, implementation, and evaluation in the context of interventions.

2.2 Material and methods

This section describes the development and testing of LESARD in the Humidtropics' action sites in Uganda, Rwanda, Burundi, and eastern Democratic Republic of Congo (DRC).

2.2.1 Development of LESARD

The development of LESARD started with a rapid literature review and workshops during the inception period of Humidtropics in late 2013 and early 2014. This review identified four key references that informed LESARD: Pali and Swaans (2013), Van Mierlo et al. (2010), Lundy et al. (2013), and Njuki et al. (2010). These references provided different frameworks and indicators that constituted the fundamentals of LESARD. The fundamentals were updated and elaborated during three workshop events: (1) planning workshop for the institutional innovation and scaling component of Humidtropics in Wageningen, the Netherlands; (2) expert meeting on participatory agricultural research: approaches, design, and evaluation in Oxford, UK; and (3) workshop on conceptualizing and metrics of capacity to innovate in Amsterdam, the Netherlands. Following the review and consultations, a test version of three major components of LESARD were developed, i.e. theory of change, results framework, and toolkits. These are described in the next section.

2.2.2 Testing of LESARD

LESARD was tested in two stages. Initial piloting was conducted between June 2014 and September 2014 in the Uganda Humidtropics action site in two MSPs, located in Kiboga-Kyankwanzi and Mukono-Wakiso, respectively. The provisional theory of change (ToC), results framework, and tools were tested for their usefulness to document, report, and analyze various R4D events, i.e. platform meetings, field monitoring visits, and training sessions. Feedback obtained from monitors[1] who implemented LESARD and other members of Humidtropics in Uganda were used to update the LESARD approach, tools, and procedures. In October 2014, an updated version of LESARD was further tested in action sites in Uganda, and LESARD testing commenced in Rwanda, Burundi, and DRC, also using the revised tools. This second testing period was finalized in December 2014, and LESARD started to be implemented fully in the four Humidtropics action sites in Uganda, Rwanda, Burundi, and DRC.

2.3 Results

2.3.1 Components of LESARD

Following the testing periods, LESARD components were updated. LESARD in its current form covers four components, each of which is briefly described in the following sections.

Theory of change and results framework

The first component of LESARD is the results framework (RF) including a generic ToC for R4D systems interventions in which MSPs fulfill a vital role. The ToC represents the concepts and their relations regarding the contribution of the MSP to the performance of interventions. RF ensures the coherence of the different components of LESARD (Figure 2-1). In the ToC, a subset of the actors in the R4D landscape (I) decide on whether or not to participate in the MSP, (II) engage in the MSP, (III) identify collectively priorities and experiment and pursue the innovations that can achieve their individual and/or collective objectives. If the MSP is effective, it (IV) produces intervention outputs such as disease resistant varieties that (V) contribute to livelihood outcomes and impact. These five parts of the ToC are an ongoing process in agricultural innovation systems.

1 Monitors are staff who are responsible for documenting and reporting platform events. In Humidtropics, they were different from maintenance and evaluation (M&E) officers, who were responsible for program M&E. Monitors were recruited, trained, and backstopped by the process research team, including authors, and reported back to stakeholders of the process, whereas M&E officers reported to Humidtropics management through separate channels.

Interventions target three major steps in the ToC and attempt to influence the process capturing steps I to V. First, they influence actors' decision to participate in the intervention. They try to create interest in the events and activities and provide incentives to participate, such as e.g. a cash allowance (A). Secondly, interventions support the MSP. For instance, through logistical support for events, researchers support more effective identification and experimentation of innovation potentials (B). Thirdly, interventions provide resources for creating intervention outputs. Provision of agricultural inputs such as high-quality seed kits and training in better use of inputs supporting the innovations developed by MSPs are two examples (C).

The ToC provides the framework and the content of the RF. The RF was formulated using an impact pathway approach and generated the following process. Initially, different intervention events, where LESARD ToC is relevant, are identified. Depending on the events, indicators are determined. Some indicators such as the planting of seedlings could be captured by pictures and can inform the RF directly. For all other indicators, a question informing the indicator is formulated. A list of all indicators is provided in the Annex to this chapter. Then, the most suitable documentation tool and best reporting tool for the each of the indicators and or questions are identified. Some reports can provide the result directly. For instance, the number of trainees attending entrepreneurship training can be reported using training reports. Other reporting tools are used for further analyses that present the results. For example, data collected by surveys are reported in online databases. In some cases, information generated outside LESARD is utilized and fed into reports. For instance, a publication about project activities in the area can provide information. Finally, the results are provided to different audiences such as the academic world, policymakers, and extension officers, all of which ultimately contributes to the targeting of outputs (Figure 2-1).

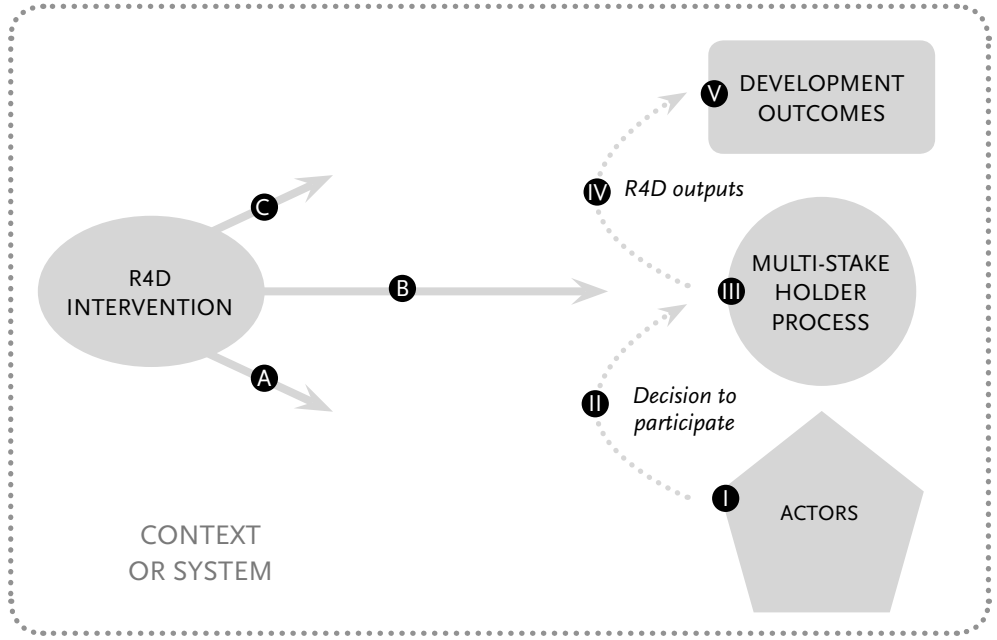
2.3.2 An example from LESARD, action orientation of Humidtropics multi-stakeholder platforms in Uganda

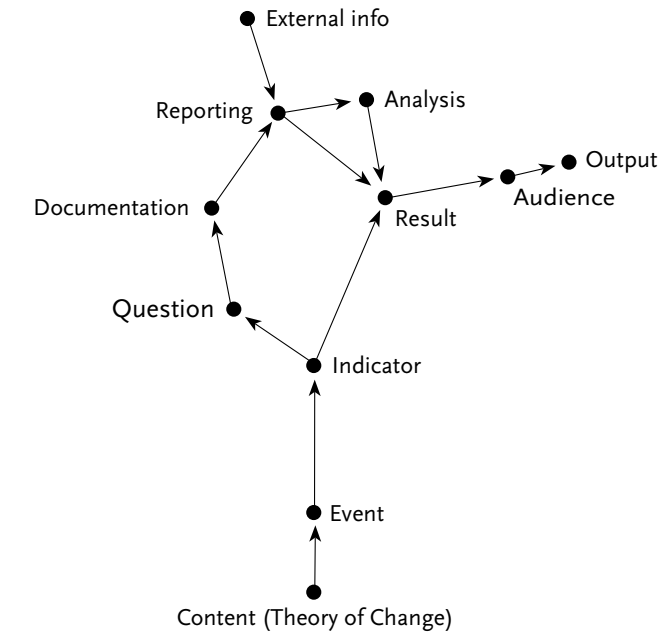
LESARD reports on 72 different indicators (Annex 2-1) and provides information about performance factors for achieving different development outcomes in Burundi, DRC, Rwanda, and Uganda. An important indicator, action orientation of Humidtropics multi-stakeholder platforms in Uganda in 2014, is used as an example to illustrate how LESARD operates (Figure 2-1) and how it contributes to development and area objectives of interventions.

How does LESARD operate?

Action orientation refers to the willingness of intervention stakeholders such as farmers or local government officials to engage in experimentation and scaling of potential innovations that contribute to livelihood outcomes and impact. Interventions aim to

Figure 2-1. Generic theory of change for interventions with multi-stakeholder platforms (above) and results framework for LESARD (below).





organize and support various actions in the innovation cycle, i.e. identify, generate, disseminate, and scale innovations, and action orientation is a performance factor relevant to interventions with an MSP theory of change. Action orientation is relevant for all events except action events, which by definition have the highest action orientation, such as planting or field monitoring. It is investigated in the majority of intervention events. The indicator used to measure action orientation is engagement level of the event, i.e. the average of individual engagement levels. Individual engagement level is a number between 1 and 6, where 6 indicates high action orientation and 1 indicates low action orientation. To determine engagement level, each event participant is asked 'what is your objective in attending this event[2]. The question is documented using the dynamic learning agenda, reported by Google forms, and analyzed using a combination of text and statistical analysis. The result of the analysis contributes to reflecting on and improving the action orientation of the intervention actors and targets all the stakeholders in the process. The indicator ultimately contributes to all objectives targeted by the R4D interventions.

How does LESARD contribute to research and development objectives of R4D interventions with MSPs?

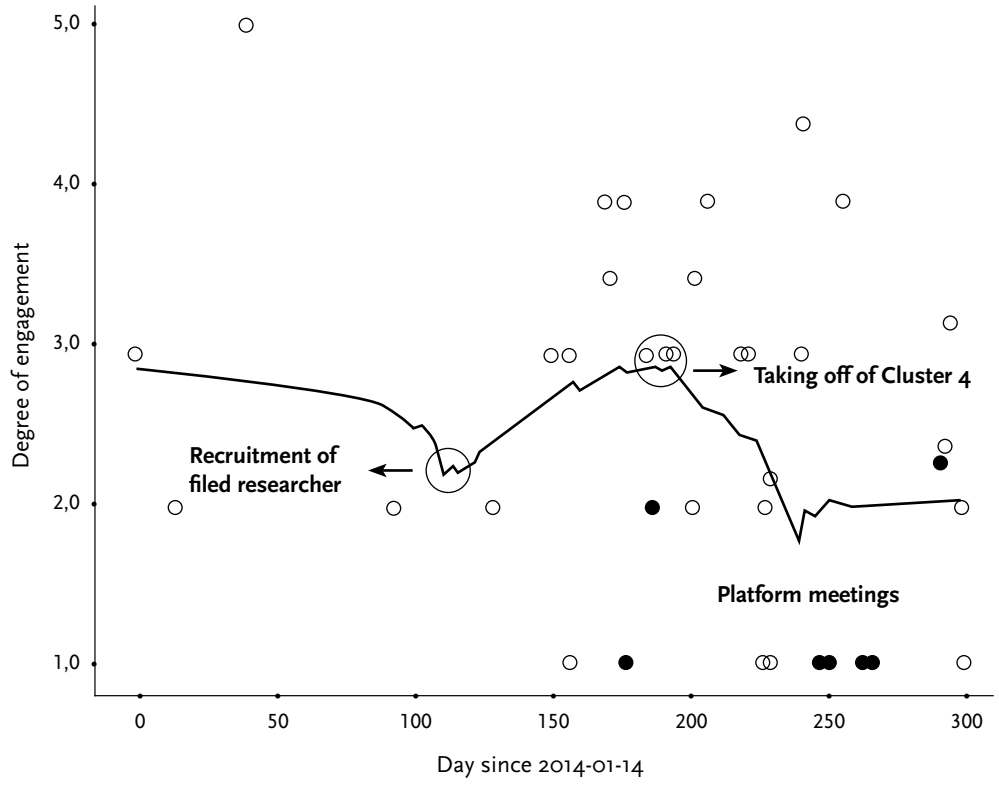
Figure 2-2 presents a graph generated in the process of validation and reflection by the researcher and stakeholders collectively. Initially, the researcher made an analysis and prepared the figure without specification of the factors causing kink points. The graph was presented in a reflection meeting attended by various stakeholders. A facilitated discussion about what the kink points could be led the participants to identify them as the recruitment of a field researcher and the introduction of a new intervention module, i.e. participant-led research. In the reflection meeting, participants first identified factors, providing qualitative evidence on factors causing the change. Second, they engaged in a discussion on how they could improve the action orientation given the results in the figure. In other words, the graph triggered action, thereby contributing to a positive change in the performance of the intervention.

Documentation Toolkit

The documentation toolkit includes the tools necessary to capture data. LESARD has a multi-layer documentation approach to capture information on the indicators listed in the results framework (Annex 2-1).

2 Responses to the question contained an action word such as present, lead. These words were classified into six groups by the engagement these words imply. For instance, present is a one-directional information provision and so signals a lower engagement than the word lead, which implies understanding, ownership, and willingness to contribute more.

Figure 2-2. Degree of engagement of intervention stakeholders. Degree of engagement is a scale classifying stakeholder involvement. It ranges from observing (Level 1) to leading (Level 6). The degree was calculated by a reference system where different action words such as work together and conduct are mapped to specific levels as owning (Level 5). For each event, presented by small circles in the graph, dynamic learning agendas filled by individual stakeholders as well as the meeting minutes were used to calculate average degree of engagement of the event, represented by a single circle. Filled circles represent platform meetings.



- The first layer consists of structured surveys, the results of which can be reported and analyzed relatively quickly. These include (1) an event log, a simple form aiming to capture factual information on events, such as date and location; (2) a learning log, where individual participants' perspectives, i.e. their objectives, priorities, are captured before and after each event; (3) participant lists; and (4) participant profiles aiming to profile the individuals and organizations in the process.
- The second layer consists of text-based tools. They include meeting minutes, reports of periodic reflection meetings, and other reports of non-meeting types of events such as field monitoring activities.

- The third layer covers photos, audio and video capturing tools of major.
- The fourth and last layer consists of e-mails and interview records.

For development and science stakeholders, the first layer is the main source of data. If the data provided by the first layer are not satisfactory, data generated by the second layer should be utilized. The same logic is applied to the following layers. For accountability purposes, minutes and reports, i.e. the second layer, are more useful. For the provision of basic dissemination information, photos, audio and video data, i.e. the third layer, are more useful and relevant (e.g. for policy and other scaling actors).

Reporting Toolkit
The reporting toolkit for LESARD consists of two major clusters of tools. The primary reporting tools consist of (1) a simple folder structure, i.e. naming rules and folder hierarchies identified in consultations with the intervention participants; (2) Google calendar; and (3) online repositories. Folder structure guides how the information is stored. Google calendar is used to compile, and notify stakeholders about, all intervention events. It provides direct access to all stakeholders and is administered by the monitors, facilitators, and organization staff. Online repositories have a storage and reporting function. They not only store data but also implement basic analyses such as descriptive statistics and basic text analysis. LESARD utilizes data-event type for naming the folders, and all relevant materials are stored in these folders. Google Forms and Google Drive are used as an integrated online repository. Dropbox is also used because of its effective synchronization capabilities. When Internet access is problematic, external hard disks are utilized for storage. The secondary reporting tools capture information provided through e-mails and web-based platforms providing different organization and communication services (e.g. WhatsApp). When stakeholders are not familiar with the primary toolkit, e-mails are used to report data.

Analysis Toolkit
The analysis toolkit has two layers. The primary layer contains tools for descriptive statistics, statistical analysis, content analysis, and social network analysis. Depending on the indicators and documentation opportunities, one or multiple tools are selected. Descriptive statistics (e.g. on stakeholder group participation, the percentage of male/females) are used by the monitors, facilitators, and organizers. Other, more analysis-intense tools such as content analysis require specialized expertise.

Tools that generate descriptive statistics are applied to inform a broad set of stakeholders and to provide quick feedback. Automated Google Form reports and Microsoft Excel are the main software tools. Statistical analysis, specifically IBM SPSS software, is utilized for understanding trends in specific performance factors and to

detect potential causes of major changes in those performance factors. Text analysis is the most commonly used content analysis method. QSR Nvivo and Atlas.ti software are used for comparing and contrasting different stakeholders' perspectives. Social network analysis tools (e.g. Gephi) are used to map existing stakeholder networks and the changes in them following the MSP. Different tools can be combined. For instance, text analysis and statistical analysis were combined to understand the action orientation of the MSP. The secondary analysis tools cover mind maps, timelines, spatial modelling, and econometric modelling. Whenever one of the tools in the primary set is not fit for the indicators or a stakeholder indicates a strong preference for them, these secondary tools are utilized. The software programs Xmind, Microsoft Excel, and Arc GIS are the basic tools in the secondary analysis toolkit.

LESARD currently covers 72 indicators that inform MSP contributions to interventions at different interfaces of changes (Figure 1-1). These 72 indicators belong to eight sub-categories. These eight categories represent components of the ToC as well as some important elements that define the characteristics of systems interventions, such as the system mindset and scale of the activities and outcomes. LESARD indicators cover a range of data types along the qualitative and the quantitative spectrum generated from various sources such as simple lists, conversations, budget tables, text analysis, social network analysis. Table 2-1 provides a sample of the indicators; the full list is provided in Annex 2-1.

2.3.3 LESARD performance principles

This section covers the performance principles that influence the effectiveness and efficiency of learning from interventions with MSPs. The principles are selected based on the experience of using LESARD in its two testing periods.

Platform meetings are just one MSP mechanism
The drivers and immediate causes of changes in complex livelihood systems are very difficult to detect. Using only the main event, the multi-stakeholder platform meetings, provides limited information about process outcomes, drivers, and factors influencing the drivers. For instance, in Humidtropics, on several occasions, a sub-group of stakeholders participating in MSP events regularly developed a partnership outside the formal platform meetings and planned changes driven by their own objectives. These spill-over process outcomes were hardly reported in the platform meetings. Thus, it is critical to document also other events such as field activities, researcher meetings, and sub-group meetings for learning. Although targeting different events does not guarantee that all drivers and immediate causes of change will be captured, it does improve the likelihood of capturing them substantially.

Table 2-1. Sample from Learning System for Agricultural Research and Development (LESARD) indicators.

Sub-category	Coverage	Sample indicators
Context	Contextual factors	Location on urban–rural gradient Population size
Actor typology	Participating actors and other stakeholders	Value chain position Centrality in collaboration network
Process drivers	Processes contributing to the generation of process outcomes	Facilitation quality Action orientation
Event typology	Events organized by the intervention	Time of the event Location of the event
Livelihood impact	Ultimate objective of the interventions	Related SDG
Scales	Scale of the activities and outcomes	Administrative scale Multi-scale index
Intervention modalities	Specific components of the intervention	Targeted ToC Financial resources Mentioned interactions among stakeholders about SDGs
System mindset	Perspectives of managers and implementers	Number of recognized limitations and unfeasible options

Both factual and perception data need to be gathered

Systems research and interventions target not only physical but also behavioral change in complex livelihood systems. It is difficult to anticipate change and the immediate drivers of change before the intervention. For instance, an MSP might display spontaneous opportunities that can increase intervention performance, and pursing them might lead to different impact pathways from those envisioned. In these emergent circumstances, it is very difficult to understand performance factors based only on tangible and physical, i.e. factual, outcomes. However, stakeholders such as facilitators, organizers, and monitors who are participating in most of the intervention events develop their opinions, and their thinking evolves as the process evolves.

These opinions and changes in thinking provide important insights into what works, what does not work, and why. The inclusion of these perceptions on performance through semi-structured periodic reflections can complement the factual data and make an important contribution to learning about interventions. For instance, the initial high engagement of farmers, local government, and local staff of national research systems in Humidtropics in Uganda was considered to be a response to the availability of funding. Nonetheless, the real fund allocation did not confirm that Uganda had more resources as compared to other action areas in Burundi, DRC, and Rwanda. Reflection with the Humidtropics Uganda team revealed that it was not the availability of funds, but rather the flexible approach on how funds could be used. Without the reflection with the Humidtropics team, it would have been very difficult to capture this perceptive evidence.

Data management system needs to provide short-term feedback

In some of the interventions, stakeholders are exposed to diverse types of data collection activities. For instance, various research teams target the same households for a better understanding of system interactions, trade-offs, and synergies. Moreover, continuous monitoring is necessary for a stronger association of the factors that affect the interfaces of change (Figure 1-1). Multiple and continuous data collection activities were reported to lead to research fatigue among MSP stakeholders (Clark, 2008), with respondents becoming reluctant to provide information or providing information of limited value (e.g. socially desirable answers). However, our testing showed that, once respondents are informed about the data collection results and how these can benefit collective decision making on current intervention issues, their willingness to answer questions and provide data increased dramatically. In the MSPs in the four countries where LESARD was tested, the participants received short-term feedback in reflection meetings that increased their willingness to contribute actively to LESARD. In other words, providing short-term feedback to stakeholders can substantially increase the ease of data collection in R4D interventions with MSPs.

Toolkits need to be easy to use and cheap

Capacity development is an integral part of interventions with MSPs. Moreover, the sustainability of intervention outcomes requires the R4D system to be strengthened in terms of identifying, experimenting, learning, and scaling innovations, i.e. to improve the capacity to innovate (Leeuwis et al., 2014). Learning approaches and tools used in MSPs contribute to stakeholders' capacity to innovate, by providing incentives, knowledge, and access to information tools that can increase the efficiency of collective decision making and action. Therefore, intervention stakeholders' access to publicly available toolkits and open access data analysis software is important for strengthening capacity to innovate. For instance, although its reporting and analysis

capabilities are more limited, Microsoft Excel was much more utilized by the Humidtropics teams than more comprehensive and more advanced (and expensive) statistical analysis tools such as SPSS, STATA, and MATLAB packages. In brief, easy to use, openly accessible and cheap tools have a higher chance of contributing to stakeholders' capacity to innovate because their chances of adoption and use are much higher.

Documentation, reporting, and data analysis needs to be conducted in a coherent manner

It is very common in interventions that only a small portion of the gathered data is utilized. Another issue is that most of the stakeholders have very limited access to the generated data and that data gathering is often incoherent, thereby complicating its analysis and the drawing of reliable conclusions. These issues combined decrease the effectiveness and efficiency of the learning processes substantially. For instance, a major reason for the long delay in reporting and analyzing baseline and situation analysis in Humidtropics is the underutilization of automated reporting, analysis tools, and lack of consideration of the extensive human and financial resources needed to analyze and report the data. LESARD utilizes a coherent approach to documentation, reporting, and analysis of learning materials to improve effectiveness and efficiency. To achieve better effectiveness and efficiency, LESARD maps each documentation, reporting, and analysis tool against an indicator and a learning question. If the tools do not result into a research question and an indicator, or require resources beyond the boundaries of the intervention, they are updated or removed. This approach minimizes redundant data collection activities.

2.4 Discussion and way forward

This chapter introduced LESARD: an action-oriented data management and decision-making support system for interventions with MSPs. Guided by its tested performance principles and through coherent combination of ToC, RF, documentation, and reporting and analysis toolkits, LESARD has the potential to contribute to increasing the effectiveness and functioning of interventions with MSPs in achieving their objectives, as well as to generating evidence on generalizable changes in intervention processes and process drivers. LESARD also combines several research approaches, i.e. quantitative analysis, qualitative analysis, and action research (Figure 1-3), which constitute the methodological foundation of the thesis.

The initial development and testing improved the performance of LESARD. It also revealed areas where LESARD can be further improved. Firstly, its implementation requires access to a diverse set of research and ICT skills by research partners and project managers. Secondly, especially in its introductory period, commitment of a team is essential. For instance, in the absence of a researcher champion, who will provide legitimacy, and a monitor, who will participate in the different events, the required continuity and coherence in the documentation of the intervention are hard to achieve.

ANNEX 2-1. List of LESARD Indicators (2016).

Context	Contextual factors	Location in urban–rural gradient Population size
Actor typology	Participating actors and other stakeholders	• Sex • Age • Civil status • Value chain position • Scales engaged in professional activity • Education level • Education compatibility • Expertise subject compatibility • Centrality in collaboration network • Betweenness in collaboration networks • Organizational position • Organizational objectives
Process drivers	Processes contributing to the generation of process outcomes	• Average number of participants attending intervention events • Sex ratio of attending participants • Age composition of attending participants • Civil status composition of attending participants • Total number of different value chain actors participating in the intervention events • Ratio of end users among the participants • Ratio of next users among the participants • Number of professions represented in the intervention • Number of expertise subjects represented in the intervention • Number of key words in the discourse of the participants • Awareness level of the targeted stakeholders on intervention activities • Co-funding by participants • Quality of the interaction facilitation in the intervention perceived by the stakeholders • Average number of participants to the events • Engagement level with the intervention • Per capita number of objectives of the participants of the intervention events • Per capita number of innovations participants of the intervention events wants to work on • Average awareness intervention stakeholders about the concepts targeted by capacity development activities of the intervention • Average awareness intervention stakeholders of the relations targeted by capacity development activities of the intervention
Process outputs	Changes in the configuration of distinct functions of innovation networks	• Average degree of knowledge exchange network • Average degree of influence networks • Average degree of fund flow networks • Average degree of social interaction network • Average degree of commodity exchange networks • Average degree of information exchange networks • Average degree of visioning networks

Context	Contextual factors	Location in urban–rural gradient Population size
Event typology	Events organized by the intervention	• Time of the event • Location of the event • Type of the event • Ratio of field events • Number of different event types per month • Number of events per month • Number of different event locations
Livelihood outcome	Outcomes that lead to realization of livelihood impact	Related Sustainable Development Goal indicators
Livelihood impact	Ultimate objective of the interventions	Related Sustainable Development Goals
Scales	Scale of the activities and outcomes	• Administrative scales intervention targets • Multi-scale index • Scale range of intervention outputs • Scales considered as relevant by the intervention stakeholders
Intervention Modalities	Specific components of the intervention	• Targeted ToC • Amount of investments per targeted stakeholders • Amount of investments per influenced stakeholder • Number of innovation champions • Number of intervention champions • Number of monitors • Number of organization and logistics support staff • Number of facilitators • Management approach • Manager background • Delegation of responsibilities • Fund disposal speed • Fund disposal flexibility
System mindset	Perspectives of managers and implementers	• Existence of organized innovation system boundary identification activity • Existence of organized innovation system elements identification activity • Mentioned interactions among stakeholders about SDGs • Number of recognized limitations and infeasible options • Ratio of the livelihood outcome and impact objectives mentioned by the stakeholders • Existence of a prioritization mechanism for identifying focus element of the intervention • Number of synergies and trade-offs articulated in the intervention strategies and implementation • Number of mentioned benefits/loss due to the interrelatedness of system elements

3

Social Network Analysis of Multi-Stakeholder Platforms in Agricultural Research for Development

Opportunities and Constraints for Innovation and Scaling

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Abstract

Multi-stakeholder platforms (MSPs) are seen as a promising vehicle to achieve agricultural development impacts. By increasing collaboration, exchange of knowledge, and influence mediation among farmers, researchers and other stakeholders, MSPs supposedly enhance their 'capacity to innovate' and contribute to the 'scaling of innovations'. The objective of this paper is to explore the capacity to innovate and scaling potential of three MSPs in Burundi, Rwanda and the South Kivu province located in the eastern part of Democratic Republic of Congo (DRC). In order to do this, we apply Social Network Analysis and Exponential Random Graph Modelling (ERGM) to investigate the structural properties of the collaborative, knowledge exchange and influence networks of these MSPs and compared them against value propositions derived from the innovation network literature. Results demonstrate a number of mismatches between collaboration, knowledge exchange and influence networks for effective innovation and scaling processes in all three countries: NGOs and the private sector are respectively over- and underrepresented in the MSP networks. Linkages between local and higher levels are weak, and influential organizations (e.g. high-level government actors) are often not part of the MSP or are not actively linked to by other organizations. Organizations with a central position in the knowledge network are more sought out for collaboration. The scaling of innovations is primarily between the same type of organizations across different administrative levels, but not between different types of organizations. The results illustrate the potential of Social Network Analysis and ERGMs to identify the strengths and limitations of MSPs in terms of achieving development impacts.

3.1 Introduction

Multi-stakeholder platforms (MSPs) are increasingly seen as promising vehicles for agricultural innovation and development (Van Paassen et al., 2014). In the field of agricultural research for development, MSPs are expected to contribute to a structural and long-term engagement among stakeholders for overcoming complex agricultural problems (Sumberg et al., 2013). Key characteristics of complex problems in agricultural systems are their multiple dimensions (biophysical, technological, socio-cultural, economic, institutional and political), and their embeddedness across different scales, hierarchical levels and interdependent actors. As a result, complex problems possess inherent uncertainties that defy prediction and linear innovation pathways (Schut et al., 2013, 2015). They are often a mix of socio-political issues where different world views, norms and values collide with different interests. Consequently, proposed solutions in different scenarios can result in turning different stakeholders into winners or losers.

The continuous engagement of various stakeholders in exploring innovations to address these complex agricultural problems is essential for three reasons. First, stakeholder groups can provide various complementary insights about the biophysical, technological and institutional dimensions of the problem, broadening the knowledge base. By engaging in a social learning process with each other, stakeholders can negotiate what type of innovations are technically feasible, economically viable, and social-culturally and politically acceptable (Schut et al., 2013; Hermans et al., 2011; Esparcia, 2014). Second, through their interaction and participation, stakeholder groups become aware of their different interests, needs and objectives, but also of their fundamental interdependencies and the need for concerted action at different levels to overcome their constraints and reach their objectives (Leeuwis, 2000; Schut et al., 2013; Messely et al., 2013). Third, stakeholders are more likely to accept or support the implementation of innovations when they have been part of its development process (Faysse, 2006; Neef and Neubert, 2011). Multi-stakeholder approaches, including MSPs, can therefore play an important role in facilitating innovation to overcome complex problems and achieving development impacts (Kilelu et al., 2013; Schut et al., 2014). Two key objectives for working with MSPs for agricultural development are (1) to enhance 'capacity to innovate' in stakeholder networks, and (2) to contribute to the scaling of innovations to achieve development impacts (Schut et al., 2016b). Over the past 5–10 years, there has been increasing enthusiasm and optimism about the role of MSPs for agricultural innovation and scaling in developing countries. Consequently, MSPs have been implemented on a case-by-case basis at selected sites. However, very little evidence has been systematically collected on whether and how MSPs actually support functions that can foster innovation and scaling.

The objectives of this paper are to explore (i) the capacity to innovate and (ii) the potential for scaling innovations of three MSPs situated in the different governance contexts of Burundi, Rwanda and the South Kivu Province located in eastern Democratic Republic of Congo (in the remainder of this paper referred to as DRC for short). To achieve these objectives, we study these MSPs from a network perspective by analyzing the linkages between different types of stakeholder organizations and how the structure of these linkages inhibits or facilitates innovation and scaling of innovation.

3.1.1 Key concepts

Innovation is defined as the successful combinations of 'hardware', 'software' and 'orgware' that have been implemented and brought into use to serve a specific public or private purpose (Smits, 2002; Mortensen et al., 2005). In this view, innovations not only require new technologies or tools ('hardware'), but also new knowledge, processes and new modes of thinking ('software') and a reordering of institutions and of organizations ('orgware'). Innovations thus emerge from the complex interactions among a diverse set of public, private and civil society actors engaged in generating, exchanging and using knowledge within a so-called Agricultural Innovation System (AIS) (Hall et al., 2003; Spielman et al., 2008). The AIS framework has broadened views of agricultural innovation processes in two important ways. First, it has recognized that actors beyond those directly involved in the agricultural production chain and the agricultural research, extension and education system play a role in innovation processes (e.g. service providers, financial sector, civil society). Second, it stresses the importance of the constraining and enabling influence of institutions (defined as the 'formal and informal rules of the game') in innovation processes (Woolthuis et al., 2005; Hermans et al., 2015; Lamprinopoulou et al., 2014).

Within this AIS framework, the capacity to innovate is defined as the ability of different groups of stakeholders to continuously identify and prioritize problems and opportunities in the dynamic environment that they are in and take risks and experiment with different new combinations of technical and institutional configurations and assess the trade-offs from these options citep (Leeuwis, 2014). Within an AIS framework, the scaling of an innovation refers not only to the successful adaptation and adoption of technologies but also to the successful implementation of new institutional arrangements to expand their impact (Uvin et al., 2000; Wigboldus et al., 2016). Two different types of scaling are relevant in this regard. Outscaling refers to the horizontal diffusion process of innovations among organizations at the same administrative level (e.g. within district, provincial, national or supranational levels). This is more or less similar to the classic (technology) adoption and diffusion model of Rogers (Rogers, 2010). Upscaling of an innovation refers to the institutional uptake or embedding of processes or technologies by organizations at higher administrative levels (e.g. across district, provincial, national or supranational levels). This process requires institutional entrepreneurship and political influence to change rules and regulations (Pachico, 2004; Van Paassen et al., 2014; Hermans et al., 2016).

Collaboration among stakeholders is a central element of the MSP approach that seeks to enhance both the capacity to innovate and the scaling of an innovation. The capacity to innovate benefits from the interaction between a variety of stakeholders with access to different sources of knowledge and power that can strengthen their collective agency (Schut et al., 2014; Hermans et al., 2013; Wellbrock et al., 2013). At the same time, collaboration connects actors and organizations within and across different administrative levels; this is important for out- and upscaling (Moore and Westley, 2011; Cash et al., 2006).

In this paper, we take a network perspective on collaboration, which means that we focus on the structure of the relationships between collaborating partners within an MSP. Collaboration processes are essentially relational in nature: they require the creation and maintenance of a connection between one or more actors or organizations. In AIS, understanding the changes in collaboration resulting from interventions such as an MSP requires monitoring changes in stakeholder networks (Hall et al., 2003). Given the relational nature of MSP activities, Social Network Analysis (SNA) offers a framework to study and model different aspects of agricultural innovation and scaling (Spielman et al., 2011; Lubell et al., 2014). SNA can enable a better understanding of the complexity and multi-dimensionality of multi-stakeholder innovation processes (Dhand et al., 2016; Beers and Geerling-Eiff, 2014).

The central question of this paper is: What relational pattern of collaborative ties in an MSP fosters (1) the capacity to innovate and (2) the scaling of innovations? We answer this question by comparing the collaborative networks of the MSPs in three countries in Central Africa: Burundi, Rwanda and DRC. As these MSPs were relatively 'young' (approximately 1 year at time of data collection), we assess their innovation and scaling potential, rather than their performance. We focus specifically on collaborative ties between organizations because those ties are also the conduits for knowledge exchange and influencing that are crucial for innovation and scaling processes. From our analysis of the innovation literature, we propose that:

- Capacity to innovate requires:
  - Broad, multidisciplinary networks with a diversity of stakeholders from business, government, civil society and knowledge institutes who contribute to effective social learning processes, identify and analyze complex problems, and explore innovations to address them (Spielman et al., 2008; Wood et al., 2014; Isaac, 2012; Röling and Wagemakers, 2000).

- The availability of powerful and influential persons or organizations within the network that can support agenda setting, mobilize resources, provide legitimacy and a mandate to create space (or niches) for innovation, and counteract resistance to change (Leeuwis, 2000; Kemp et al., 1998; Schot and Geels, 2008; Hekkert et al., 2007).

- The potential for upscaling and outscaling innovations depends on the characteristics of the collaborative network. More specifically:
  - Dense collaborative networks facilitate the exchange and dissemination of information.
  - To ensure upscaling, organizations at different administrative levels have to be connected to each other, so that information and other resources can flow easily across different levels.

These network characteristics are summarized in section 3.1. It has to be noted that these network characteristics are formulated fairly broadly, and we do not want to suggest that there is an optimum network configuration that maximizes the innovation or scaling potential in all governance contexts. A diverse group of stakeholders who draw on different sources of knowledge is important to solve complex problems, but when the cognitive distance between actors becomes too large it becomes difficult to establish common ground (Nooteboom et al., 2007; Beers et al., 2014). Similarly, there comes a point when the density of a network can become problematic. Isaac (Isaac, 2012), for example, explains how knowledge networks with high density may result in collective action (essential for scaling) but little new information (essential for innovation), whereas a low density network may invite new information (essential for innovation) but the exchange of such information may be impeded (essential for scaling). Powerful actors in the network can facilitate change, but they are also likely to be invested in the status quo and therefore can stifle innovations that threaten their power base (Smith et al., 2014).

It is clear, therefore, that the effectiveness of an innovation network depends on the context and the actors involved. In this regard, it is helpful to think about these characteristics as the opposite of some well-known innovation failures: sparse, disconnected innovation networks represent a barrier, or a systemic innovation failure (Woolthuis et al., 2005), and without influential organizations present in the network no changes can be made at all. Furthermore, we assume that, within the context of Central Africa, the lack of innovation capacity and the resulting innovation failures have to do with a dearth of linkages between organizations and coordination efforts across scales, and therefore MSPs have been established with the particular aim of remedying some of these network failures (Schut et al., 2016c,b).

From the innovation network characteristics in Table 3-1, we can identify a number of social processes at the micro level that might result in empirically observable innovation networks with high capacity to innovate and high scaling potential. We assume that when 'opposites attract' (a process also referred to as heterophily in the network literature), this will result in a broad and diverse network connecting different types of organizations. With regard to the capacity to innovate, we hypothesize that in MSPs:

1. Organizations (e.g. farmer, government, NGO, business, research) tend to form more network links with different types of organization.
2. Organizations that are perceived as being influential will be preferred collaboration partners for stakeholders in MSPs. Therefore, influential partners should end up in more central positions in the collaborative network.

Table 3-1. Network characteristics to evaluate capacity to innovate and scaling potential of MSPs.

Network objective		Network process Knowledge exchange	Influence
1	Capacity to innovate	1a Broad networks with multidisciplinary partners enhance social learning	1b Centrality of influential organizations within the network facilitates institutional entrepreneurship, agenda setting and creation of space for experimentations
2	Scaling of innovation	2a Dense collaborative networks facilitate the exchange and dissemination of information (outscaling)	2b Multi-level networks facilitate the institutionalization of an innovation (upscaling).

To ensure processes of outscaling and upscaling, information and knowledge have to flow among organizations located within and across different levels. With regard to scaling, we can hypothesize that:

3. Information travels more easily in denser innovation networks, this is beneficial for scaling.
4. Organizations with knowledge will make for more attractive collaboration partners.
5. Organizations tend to form more network links across administrative levels as compared to organizations operating at the same level (local, provincial, national or supranational).

In the remainder of this paper, we use these five hypotheses to identify and explain the characteristics, similarities and differences of the MSP networks in Burundi, DRC and Rwanda.

3.2 Methodology

3.2.1 Study sites

Data for this study were gathered within the framework the CGIAR Research Program on Integrated Systems for the Humid Tropics (Humidtropics), which has adopted the MSP approach for achieving its development outcomes. Research for Development Platforms and Innovation Platforms are core tools of the Humidtropics intervention strategy to bring together relevant actor groups and organizations, and to stimulate working together towards the realization of development outcomes. The collaboration between Innovation Platforms and Research for Development Platforms is expected to facilitate awareness about local innovations (tested in Innovation Platforms) at the (sub-)national level (in Research for Development Platforms); this can stimulate lessons and innovations to go to scale.

Data were collected with three Research for Development Platforms in the action sites in Burundi, DRC and Rwanda. Note that the DRC study site is about double the area but half as populous as those in Rwanda and Burundi. The selection of these three sites is based on several interesting similarities and differences regarding agricultural innovation (Van Damme, 2013). Similarities are related to key agro-ecological and demographic features and agricultural productivity challenges. In general, the region is densely populated; agricultural pressure on land is high, and farm sizes are small (Vanlauwe et al., 2013). In these highly populated areas, soil fertility is one of the main constraints of agricultural production, driven by (i) absence of nutrient inputs, (ii) soil erosion and (iii) sub-optimal agricultural practices (Schut et al., 2016c,b; Van Damme, 2013; Vanlauwe et al., 2013). Differences can be found in the governance context with the position and role of the government being different in the three countries: DRC (very decentralized) and Rwanda (very centralized) forming the two ends of the spectrum. As a result, there are also differences in the effectiveness of public governance (i.e. formulation and implementation of policy), which is generally perceived as low in eastern DRC, medium in Burundi, and high in Rwanda (Lemarchand, 2006).

3.2.2 Data collection, cleaning and analysis

Humidtropics initiated MSPs for innovation and scaling based on three types of stakeholder mappings. The first approach was to identify long-term established partners of the CGIAR centers in Burundi, eastern DRC and Rwanda. The second approach was participatory stakeholder mapping based on Humidtropics workshops for which potential partners were invited. The third approach was to prepare dissemination materials about the program and distribute them in different locations (Muchunguzi et al., 2016) to encourage organizations to join the MSP. Thus, different types of organizations were provided the opportunity to form part of the MSP.

Data for the network analysis were gathered during MSP meetings in Burundi, Rwanda and DRC in August 2014. Data were gathered during a regular MSP meeting where ongoing research and development activities are discussed among the participants. Data collection was undertaken by the authors and harmonized across the three countries by using a detailed protocol. A name generator (open nomination) was employed based on the following question: 'Compose a list of the names of all organizations with whom you collaborate'. In subsequent steps, respondents were asked to identify within their initial list the five organizations that they viewed as the most important for knowledge exchange (question asked was: 'go through the list and circle the 5 organizations on the list that are most important for knowledge exchange') and the five organizations that they viewed as the most influential (question asked was: 'Go through the list again and now underline the 5 organizations that you think are most influential'). In addition, the following information was collected: 1) name, gender, age and (multiple) affiliation(s) (questions asked were: 'Write your name on the sheet of paper', 'Indicate your gender and age' and 'Write down ALL the names of organizations/companies/institutes etc. that you represent'). The data collected therefore represent a 'one-wave snowball sample' of the platform. As the data were gathered at the same meeting, there is some overlap between the organizations mentioned by the participants: some of the named 'alters' also appear on the 'ego' list. For Burundi, the overlap between egos and alters was 7.0 %, for DRC 7.8% and for Rwanda 5.6%. In total, 45 respondents representing three MSPs contributed to data gathering. The average age of the respondents was approximately 43 years. Of the respondents, 78% were male. See Table 3-2.

Table 3-2. Characteristics of respondents (M = Male, F = Female).

Country	Respondents	Average age	Gender M-F	Total number of distinct affiliations
Burundi	14	42	10 - 4	15
DRC	21	43	16 - 5	35
Rwanda	10	43	9 - 1	7
Total	45	43	35 - 10	

Data were entered and cleaned by the authors. Local MSP facilitators supported the authors in matching organizational abbreviations and full names, French versus English abbreviations and organization names, deciphering handwriting and misspelling of organization names and abbreviations. Furthermore, the MSP facilitators provided additional information on the type of organization (farmer organization, NGO/civil society, private sector, government, research and training) and the principle administrative level at which these organizations are active (supranational, national, provincial, district). The resulting networks are provided as csv files in 3.4 File, which also includes the organizations' names, abbreviations levels and typology. Our participatory observations in the MSPs analyzed in this paper enabled us to interpret the data and results.

3.2.3 Social network analysis and Exponential Random Graph Models

We have applied exploratory social network analysis (Wasserman and Faust, 1994; De Nooy et al., 2011)in combination with Exponential Random Graph Models (ERGMs). ERGMs belong to the class of statistical inference models and are among the most popular and theoretically well-developed class of network models (Snijders, 2011). ERGMs are used for testing hypotheses about the social processes that might have led to the creation and development of an empirically observed network. The statistics in these models are based on the occurrence of certain micro-level patterns of ties that indicate specific mechanisms of tie formation at work. Examples are preferential attachment (to popular nodes), reciprocity between nodes (resulting in the formation of a double arrow), transitivity (friends of friends are likely to become friends), resulting in a local triangle structure and processes of homophily in which two nodes with the same trait are more likely to form a tie. ERGMs are used to test statistically whether the relative occurrence of such patterns is consistent with these underlying dynamic processes of network formation. For a more detailed introduction to ERGMs see Lusher et al. (2012), Harris (2013), and Lubell et al. (2014). The analysis of network properties and ERGM specification was conducted in R, using the statistical 'statnet'' package (version 2016.9) (Handcock et al., 2008), and the associated 'ergm.ego' package (version 0.3.0) (Krivitsky, 2012). See section 3.7 for an overview of the analysis code used. The 'ergm.ego' package was developed especially for ego-networks. In such ego-networks, the collected data are considered to be a sample of a larger network of a known, or unknown size. In our case, we did not know the total size of the population network of the AIS in all the three countries. In addition, MSP membership is not fixed: it changes over time and the sample therefore necessarily only captures a snapshot picture of the ego-networks of MSP participants that in reality is a dynamic process of collaboration and partnering. Nevertheless, the sample represents a reliable picture of the typical ego-networks at national level in Burundi and Rwanda and at provincial level in DRC and therefore can be used as input for ego-network modelling. The ergm.ego package is based on the finding of Krivitsky et al. (2012) that it is possible to obtain a 'per capita' size invariant parameterization for dyad-independent statistics by using an offset that preserves the mean degree (approximately equal to -log(n), where n is the number of nodes in the network). Simulations have suggested this is also possible for some dyad-dependent statistics. However, the processes of so-called network self-organization at the level of the entire network (like triadic closure, degree assortativity and 4-cycles) are not incorporated in the ergm.ego package. In their description of the package, Krivitsky and Morris (2017) state that, if the population network is not overly large, the parametrization of such higher order effects might not be necessary.

Terms were added in consecutive blocks (node level and dyad level) to examine their relative contribution to enhancing the goodness-of-fit of the models (Goodreau, 2007). Three models were tested and evaluated: starting with a simple random graph model (M0) (where all nodes have an equal chance to form a tie) and adding complexity in subsequent models by adding terms corresponding to our hypotheses at the node level (M1) and the dyad level (M2). We have scaled all our results to a 'pseudo-population' size of 1000 for all three countries, following the advice of Krivitsky and Morris (2017). At the node level, we look at the degree (number of ties) that organizations have within the knowledge network to test hypothesis 3. The knowledge degree serves therefore as an indication of the perception of other actors that an organization possesses complementary knowledge. Following the AIS perspective, we assume that such relevant knowledge is not limited to research and extension organizations, but is also possessed by farmers, NGOs, businesses, etc. To operationalize hypothesis 2, we take the degree of organizations in the influence network as a measure of their perceived power. Again, it is not only organizations that are deemed to be powerful; other types of organizations can possess other forms of power (Avelino and Rotmans, 2009). At the dyad level, we look at ties between different types of organizations. A typology was made of six different categories of actors: 1) business, 2) farmer, 3) government, 4) non-governmental organizations (NGOs), 5) research, training and extension, and 6) unknown. Hypothesis 1 is thus tested by looking at the tendency for different types of organizations to form collaborative ties. Finally, for scaling, we look at the administrative level where organizations are (most) active: 1) local, 2) provincial, 3) national, 4) supranational or 5) unknown. Hypothesis 4 is tested by investigating the tendency of actors working at different levels to form collaborative ties.

Models were checked for potential degeneracy (see S2 File) and goodness-of-fit through visual inspection of the standard plots that the statnet package generates for this purpose, as suggested by Hunter et al. (2008). As all the models underestimated the number of organizations by a degree of 1, we fixed this amount in the models

to increase the fit. To ease comparison of the plots, we calculated a goodness-of-fit percentage following the example of Harris et al. (2012). The calculated percentage is based on the proportion of the relevant degree distribution that falls within the 95% confidence intervals of simulations based on the models. The term relevant here is not defined for all degrees, but only those degrees where the results of either the ergm.ego model or the original measurement show a value unequal to 0.

3.3 Results

3.3.1 Descriptive network characteristics

Because of the slight overlap in egos and alters in each country, we can depict the different networks in each country as if they are complete networks. We have thus constructed three networks for each country (Figure 3-1) a collaborative network based on organizational ties (first row), a knowledge exchange network (second row) and an influence network (third row). Even though ego-networks are typically directed, we have defined collaboration and knowledge exchange as a mutual relationship. These networks were therefore defined as undirected networks. No loops were allowed in these networks. This implies that a respondent cannot exchange knowledge or collaborate with his or her own organization. Influence was defined as a directed network and respondents were allowed to consider their organization as influential, thus including loops in the networks. Below, we describe these networks and their implications for the capacity to innovate and scaling in more detail. In Table 3-3, the collaborative networks are broken down according to the administrative level at which the organizations operate. In the collaborative networks in Rwanda and DRC, the majority of organizations operate at the supranational level. In Burundi, the national level is the best represented. In Rwanda and Burundi, some levels are missing in the network. In Rwanda, the provincial level is almost completely absent, and in Burundi the district level is almost completely absent.

Collaborative networks

The collaborative network is smallest in Rwanda and largest in DRC (Table 3-4.) In all three countries, the networks are dominated by NGOs in terms of composition. In Burundi and Rwanda, government organizations rank second. In DRC, the second place is taken by research and training organizations (21%), but the difference between those and government organizations (18%) is rather small. Private sector organizations are almost absent in all three countries.

Figure 3-1. Overview of MSP networks for collaboration, knowledge exchange and perceived influence

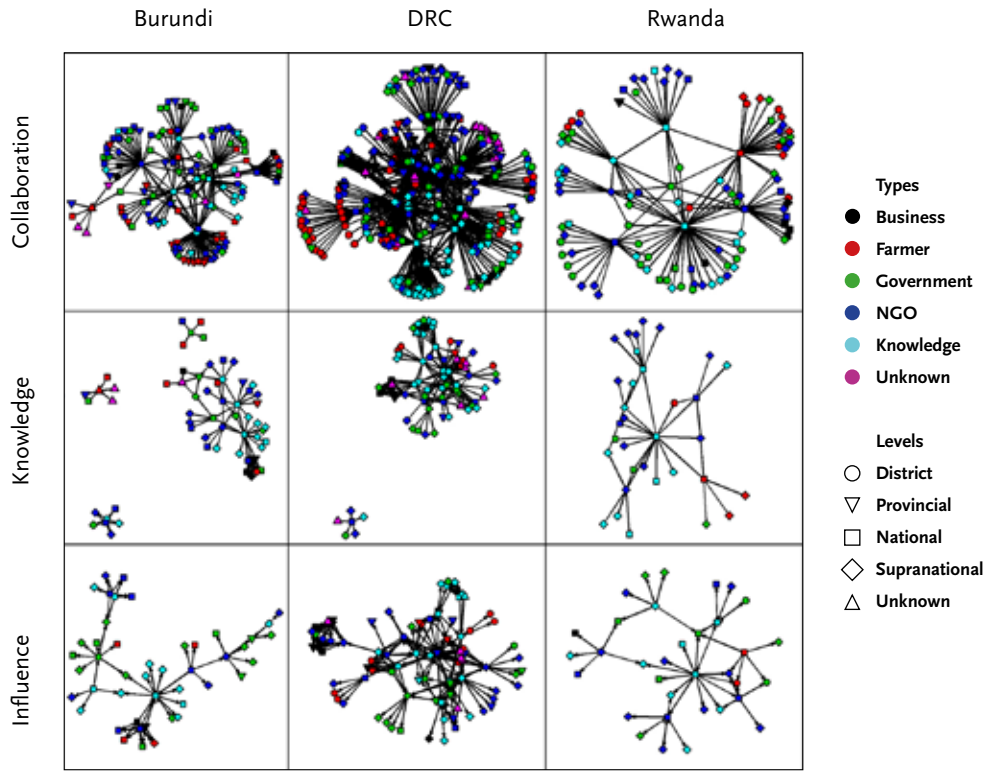


Table 3-3. Collaborative network composition and characteristics.

Country	Farmer Organizations	NGO	Private sector	Government	Research and training	Unknown	Total nodes (g)	Total ties (L)
Burundi	27 (19%)	51 (36%)	8 (6%)	32 (23%)	19 (13%)	5 (5%)	142	237
DRC	45 (16%)	82 (29%)	24 (9%)	50 (18%)	59 (21%)	20 (7%)	280	903
Rwanda	14 (13%)	36 (33%)	6 (6%)	32 (30%)	20 (19%)	0	108	142

Table 3-4. Number and (percentage) of organizations per level in the collaborative network.

Country	District	Provincial	National	Supranational	Unknown	Total organizations
Burundi	3(2%)	33(23%)	57(40%)	45(32%)	4(3%)	142
DRC	65(23%)	57(20%)	36(13%)	101(36%)	21(8%)	280
Rwanda	24(22%)	1(1%)	23(21%)	60(56%)	0	108

Knowledge exchange networks

The knowledge networks in Burundi and DRC show multiple components; this means that the knowledge networks are disconnected and thus will inhibit scaling (Figure 3-1). Our data show that knowledge is being exchanged between different types of stakeholder groups (Table 3-5). However, for all three countries farmers and businesses are the smallest categories of organizations with which knowledge is exchange. Somewhat surprisingly, it is not the research and training organizations that dominate, but the NGOs that make up the largest part of the composition of the knowledge networks in Burundi and Rwanda. These NGOs often operate at international level (Table 3-6).

Table 3-5. Composition of the knowledge exchange networks.

Country	Farmer Organizations	NGO	Private sector	Government	Research and training	Unknown	Total	Share of collaborative network
Burundi	8 (13%)	21 (34%)	5 (8%)	10 (16%)	14 (23%)	3 (5%)	61	43%
DRC	7 (9%)	18 (23%)	6 (8%)	15 (19%)	24 (31%)	7 (9%)	77	28%
Rwanda	4 (12%)	14 (42%)	0	3 (9%)	12 (36%)	0	33	31%

Table 3-6. Number and percentage of organizations per level in the knowledge networks.

Country	District	Provincial	National	Supranational	Unknown	Total organizations
Burundi	1(2%)	5(8%)	25(41%)	26(43%)	4(7%)	61
DRC	10(13%)	14(18%)	11(14%)	34(44%)	8(10%)	77
Rwanda	1(3%)	0	10(30%)	22(67%)	0	33

However, even if NGOs are more present within the network, it is some of the research and training organizations that hold the most central position in the knowledge network, as they have the highest degree of organizations within the knowledge network (Figure 3-2). In DRC, the research and training organizations have the largest share of the knowledge network, but it is an NGO that has the highest degree. However, three research and training organizations are also among the organizations with a central position in the knowledge network in DRC.

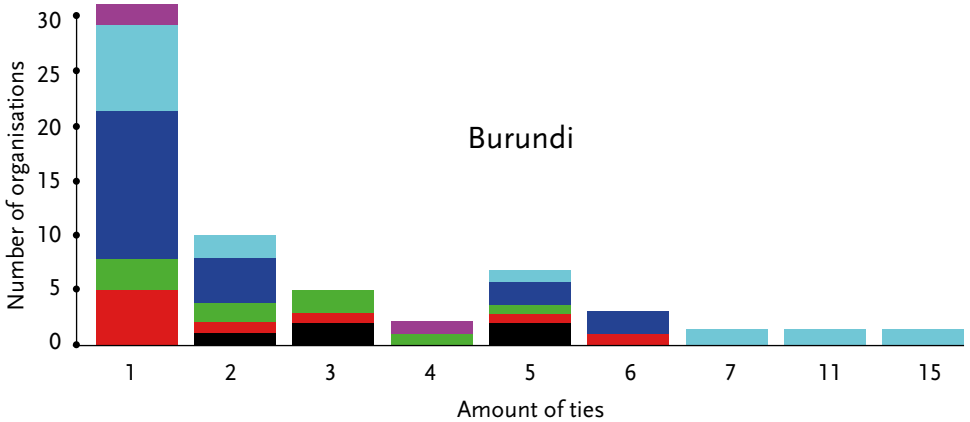
Influence networks

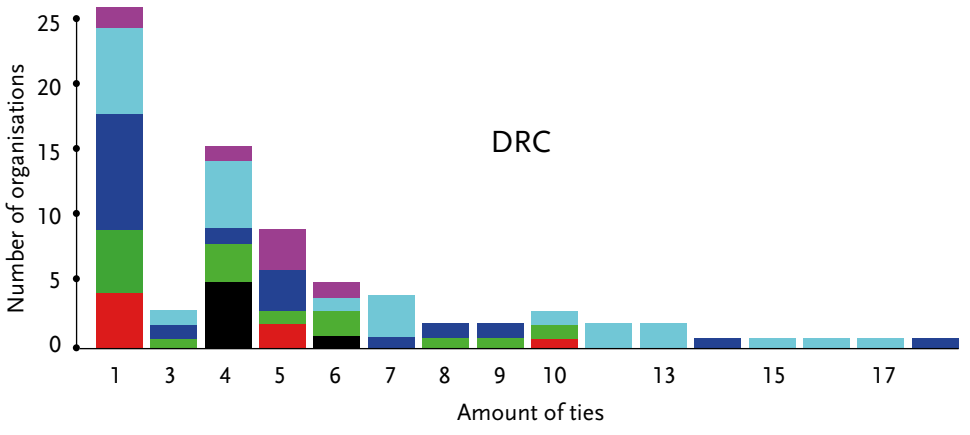
Tables 3-7 and 3-8 give an overview of the influence networks in terms of composition and administrative scale. NGO, government and research organizations are the most important source of power in all three countries, although their ranking is slightly different (Figure 3-3). In Burundi, the government is the largest type of actor in terms of influence. In Rwanda and DRC, the NGOs are the most important. Influence in these countries is thus mainly derived from legislative power (government), monetary power (government or NGOs), or knowledge (research institutes or NGOs).

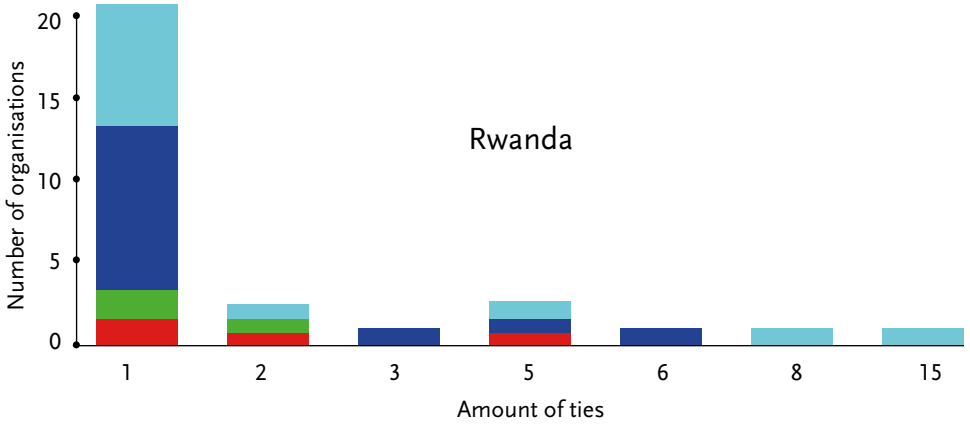
Table 3-7. Composition of the influence networks.

Country	Farmer Organizations	NGO	Private sector	Government	Research and training	Unknown	Total	Share of collaborative network
Burundi	4 (9%)	11 (24%)	2 (4%)	16 (35%)	13 (28%)	0	46	32%
DRC	12 (14%)	24 (28%)	9 (11%)	16 (19%)	19 (22%)	5 (6%)	85	30%
Rwanda	2 (6%)	13 (38%)	1 (3%)	9 (26%)	9 (26%)	0	34	31%

Figure 3-2. Distribution of knowledge degrees among different types of organizations.







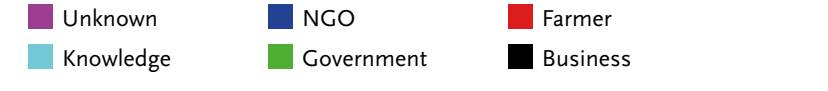
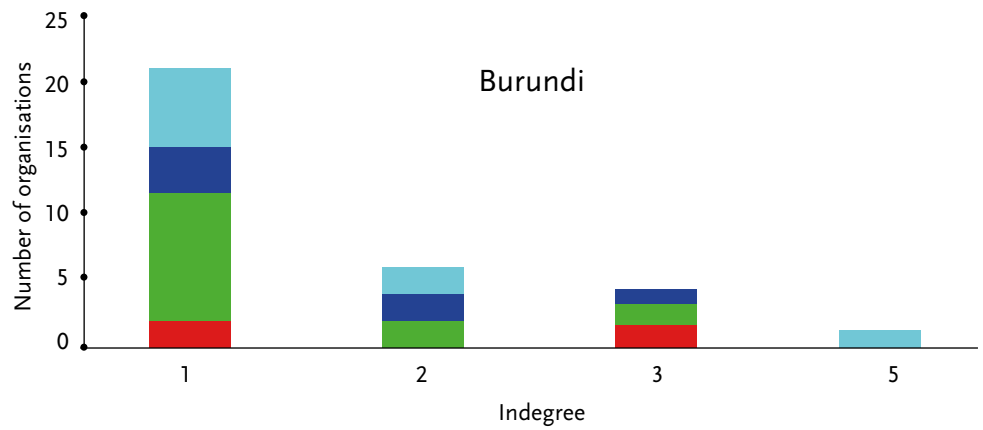
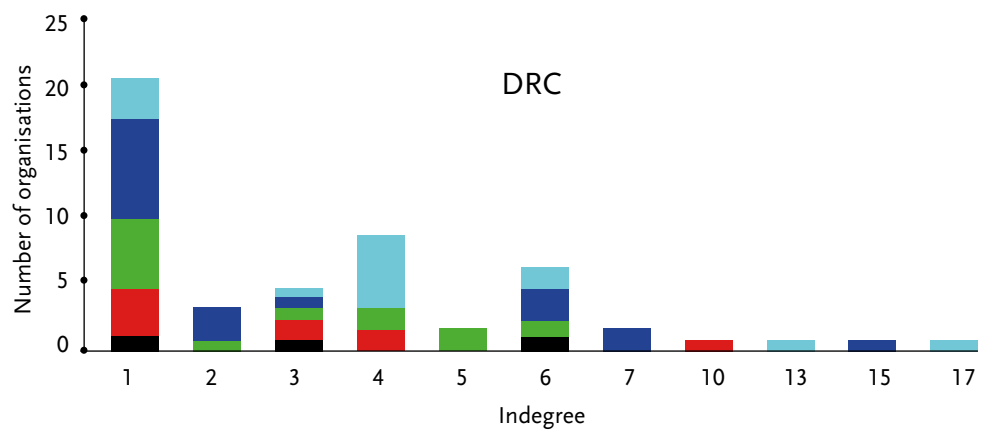
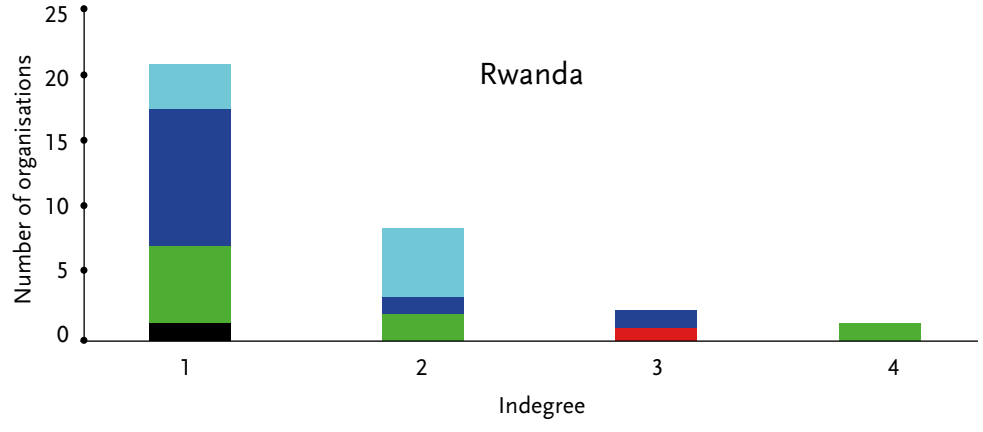


Figure 3-3. Distribution of influence in degrees among different types of organizations.







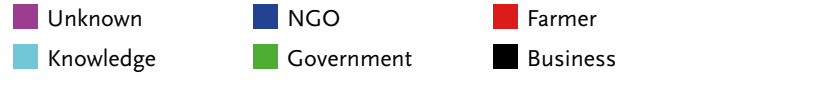


Table 3-8. Number and percentage of organizations per level in the knowledge networks.

Country	District	Provincial	National	Supranational	Unknown	Total organizations
Burundi	1 (2%)	3 (7%)	18 (39%)	24 (52%)	0	46
DRC	14 (17%)	21 (25%)	10 (12%)	34 (40%)	6 (7%)	85
Rwanda	3 (9%)	0	12 (35%)	19 (60%)	0	34

In all three countries, the international level is the most important in the influence network, followed by the national level. The exception is DRC where the national level is not so present, but this has to do with the fact that the MSP is organized at the provincial level (i.e. South Kivu) and not at the national level.

3.3.2 Results of the ERGMs

Four models were tested and evaluated: starting with a simple random graph model (M0) and adding complexity in subsequent models by adding terms corresponding to our hypotheses at the node level (M1) and the dyad level (M2). Figure 3-4 shows the result of the goodness-of-fit percentage for the degree distribution across the three models. The differences between goodness-of-fit between the M1 and M2 models is very small, and they lie within the same range. In order to compare the countries and test our hypotheses, we used the results of the M2 models for all three countries. Figure 3-5 shows the goodness-of-fit for the model parameters for these model fits.

Table 3-9 gives an overview of the results of the full ERGM models (M2). An overview of the ERGM results of M0 and M1 can be found in 3.7. Regarding our first hypothesis, we find that links between the same type of organizations are positively correlated at a significant level in two of the three countries (Burundi and DRC). This means that, instead of heterophily, we find a tendency towards homophily ('birds of a feather flock together') as indicated by the positive estimates. Organizations of the same type have a 1.36 times chance of forming a collaborative tie in Burundi and a 1.56 times greater chance in DRC.

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Figure 3-4. Goodness-of-fit over the degree distribution for different model forms.

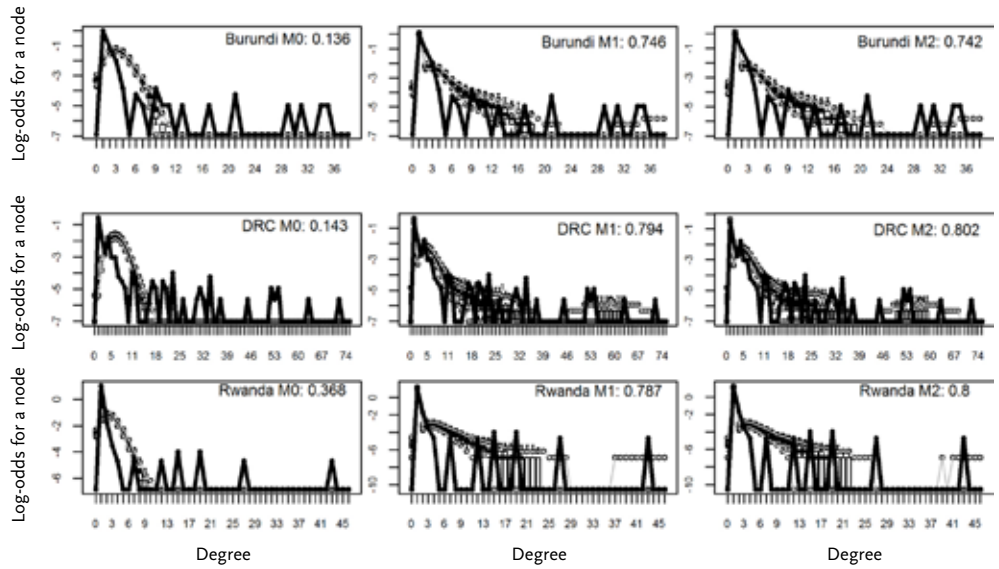


Figure 3-5. Goodness-of-fit diagnostics over model (M2) parameters.

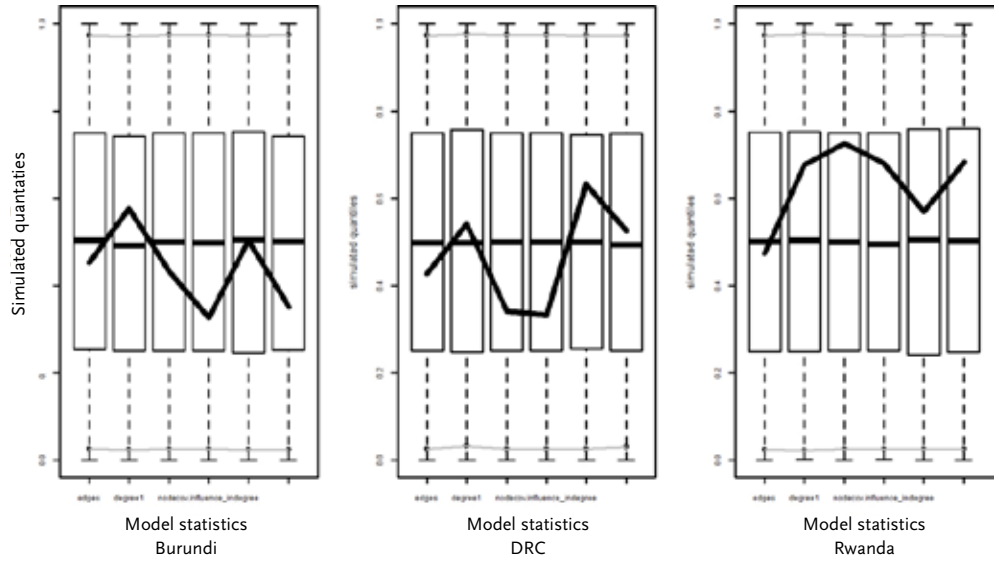


Table 3-9. Exponential random graph models for collaborative networks in Central Africa.

	Network size adjustment	Edges	Degree (1)	Knowledge degree	Influence degree	Administrative level	Organizational type
Burundi							
Estimate	-6.90	0.87	1.95	0.26	-0.23	-0.54	0.30
Std.Error		0.32	0.52	0.02	0.08	0.18	0.14
Odds ratio		2.39	7.01	1.30	0.79	0.59	1.36
DRC							
Estimate	-7.02	0.08	2.94	0.06			0.45
Std.Error		0.13	0.40	0.04			0.14
Odds ratio		32.28	18.82	1.06			1.56
Rwanda							
Estimate	-6.88	1.57	3.74	0.19		-0.42	
Std.Error		0.56	1.05	0.03		0.19	
Odds ratio		4.82	41.98	1.21		0.66	

Only significant coefficients are reported.

[a] Network size adjustments are fixed by offset and are not estimated: pseudo-population = exp(-netsize adj.).

The second hypothesis regarding the effect of power and influence is not substantiated. In Burundi, we find a negative estimate (-0.23). This indicates that, for each additional degree an organization has in the influence network, it is 0.79 times less likely to form a collaborative tie. For DRC, we also find such a negative estimate, although here the effect is not significant. In Burundi, influential organizations are either collaboration averse or they are being ignored by other organizations for collaboration. In Rwanda, the estimate also falls outside the cut-off rate for significance of p 0.05.

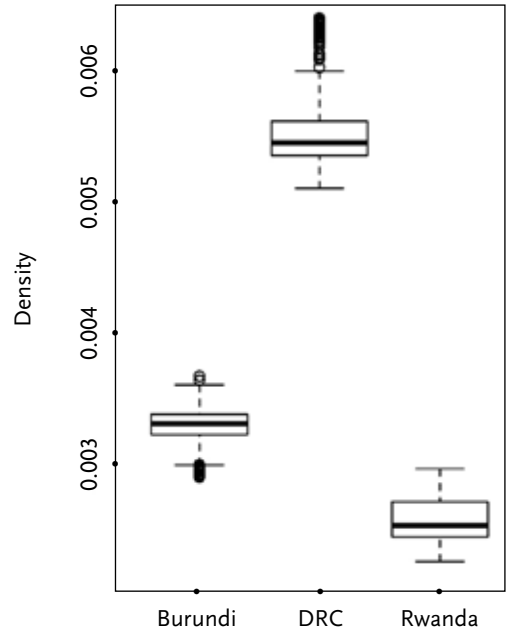
The strongest effects we find relate to the effect of the knowledge degree of organizations as indicated in hypothesis 4. We find that, in all three countries, knowledge degree is positively correlated with the number of ties an organization has in the collaborative network. This effect is strongest in Burundi, where an additional degree in the knowledge network corresponds to 1.30 times the number of ties in the collaborative network. For Rwanda and DRC, this effect is also positive albeit smaller (with odds ratios of 1.23 and 1.06, respectively). This confirms hypothesis 4 that knowledge exchange is significantly correlated with the number of ties in the collaborative network. With regard to heterophily between administrative levels as proposed in hypothesis 5, we found significant effects for the Burundi and Rwanda MSPs. Organizations

working at the same level have a smaller chance of forming a tie (indicating a higher chance for organizations at different levels to form ties).

Hypothesis 3 states that denser networks perform better with regard to scaling. Results from the ERGM helped us to calculate the densities and the mean degrees of the three networks. Because of the unknown complete network size, they could not be derived directly from the sampled ego-network. However, the results of the ergm.ego were scaled to a network of 1000 nodes for all the three countries and this allowed us to compare the tendency of the organizations to form ties.

Figure 3-6 shows the three boxplots resulting from a simulation using the ergm.ego results to draw 1000 networks for a network of 1000 nodes. It shows that densities and mean degrees for Rwanda are the lowest and for DRC are the highest. From this result, we conclude that DRC has the highest propensity to form collaborative ties and Rwanda has the lowest propensity to form a dense network. Even though it is not possible to compare these figures against an objective benchmark, we can assume that scaling in DRC will likely have the best results, compared to Burundi and Rwanda.

Figure 3-6. Boxplots for density based on 1000 generated networks with ERGMs for the three countries.



3.4 Discussion

3.4.1 Limitations of the study and sampling

We have conceptualized the collaborative ties between organizations as the connections through which knowledge and influence are effectuated, and consequently we did not ask respondents to name separately the organizations with which they collaborate, exchange knowledge and find influential. Instead, we asked them to name their collaborative partners and then to choose from within this list the five organizations with which they exchange the most knowledge and the five organizations which they consider to be the most influential. The formulation of the question might have led us to exclude important knowledge or influential organizations within the broader AIS. Furthermore, it might provide a bias towards highly connected organizations within the collaborative network with regard to knowledge and influence degrees. However, the results of the ERGM calculations (especially for the influential organizations) do not suggest this. On the contrary, we conclude that more influential organizations are less likely to form collaborative bonds in Burundi. The conclusion that organizations with a high knowledge degree are more likely to form collaborative bonds might indeed suffer from this bias. This represents a limitation of this study but, given the well-established link between knowledge creation and innovation in the existing innovation literature, we think that this bias did not influence the conclusions of our study.

Another limitation of the study has to do with our decision to model the networks as ego-networks. The data sampling for the networks was based on a one-wave snowball sample and this is not exactly the same as the ego-networks described by Krivitsky and Morris (2017). By modelling our collaborative networks as ego-networks, we have essentially ignored some of the additional information contained in our sample regarding alter-alter ties that could be used to model higher-order effects such as tendencies for triadic closure. By applying ergm.ego modelling, we have assumed that the overlap between egos and alters is small enough (for Burundi 7.0%, for DRC 7.8% and for Rwanda 5.6%) to be able to ignore these triadic effects. However, it would be good to check this assumption by gathering more information on the networks of actors within AIS that are linked to the MSP but not a direct member of it in a later stage.

3.4.2 Capacity to innovate in the MSP networks

Regarding the capacity to innovate, we find that the absence of businesses in the collaborative network in all three countries means that stakeholder representation in the networks is not proportionally balanced, and this might negatively affect the capacity to innovate. The MSP may respond less to the needs of the private sector and entrepreneurial activities – a response that forms a core function of technological innovation networks (Hekkert et al.,2007; Suurs, 2009). The knowledge networks are

dominated by NGOs (in terms of presence) and research and extension organizations (in terms of degree centrality). The underrepresentation of farmer organizations and businesses in the knowledge exchange networks of Burundi and DRC may further exacerbate this potential weakness of the three MSPs in terms of their capacity to innovate. In other words, capacity for innovations that require a high level of knowledge exchange (e.g. local adaptation of cropping practices) is relatively weakly developed in these MSPs. A potential explanation is that the MSPs in this study prioritized removing institutional rather than technical barriers to agricultural development (Schut et al.,2016b).

The results of the ERGMs showed that the collaborative networks are important conduits for knowledge exchange, as the organizations that possess complementary knowledge are more likely to be collaborated with. In contrast, the effects of influence differ from country to country.

When comparing the densities (and mean degree of collaboration) of the collaborative networks in the three countries, we observe that DRC is highest followed by Burundi and Rwanda. This means that – on average – organizations in DRC collaborate more with other organizations than in Burundi and Rwanda. On the basis of our proposition, the capacity to innovate in DRC will benefit from this dense network. A potential explanation for the high mean degree in DRC is that general partnerships as well as social capital among organizations are relatively more developed. This iarises from necessity, because state governance systems to support farmers and other stakeholders are much weaker in DRC. From a study of social capital among farmers in DRC, Lambrecht et al. (2014) concluded that social capital indicators affect not only awareness, but also capacity to innovate, to which they refer as 'try-out'. In Rwanda, the state fulfills a much stronger governance role in the network. Burundi is a mix of the governance models in both Rwanda (with a centralized government) and DRC (where the government role is taken over by NGOs), with a mix of government and NGO influence.

Influential organizations are less likely to be collaborated with in Burundi and capacity to innovate could suffer, as there may be insufficient actors who can create space to experiment and create legitimacy of new innovations.

3.4.2 Scaling of innovation in the MSP networks

The structure of the collaboration networks, the knowledge networks and the influence networks can tell us about the potential of the MSP to support the scaling of innovation within levels (outscaling) and across different levels (upscaling). The collaborative networks analyzed in this study were dominated by supranational and

national organizations (associated with the National Agricultural Research System: NARS), whereas local organizations were mostly absent. The central position of NARS in the knowledge networks provides both opportunities and constraints for scaling innovation. NARS and its extension systems form part of broader AIS that have the ability and infrastructure to reach many farmers and other stakeholders (Rivera and Sulaiman, 2009a). However, incumbent research and training systems have path dependencies, sunk investments and a certain institutional logic, which is not easy to change and their efficiency and innovation capacity is often low (Rivera and Sulaiman, 2009b; Aguilar-Gallegos et al., 2015). The question is therefore whether the prominent placement of these types of organizations within the MSP networks will foster or hamper the removal of institutional barriers to innovation and scaling.

In all three countries, the local and provincial levels are mostly absent from the influence and knowledge networks, this might indicate poor connectivity between this level and the national level of the MSP, and vice versa. Other studies confirm that MSPs implemented in such linear systems will reinforce the top-down transfer of innovation paradigm, rather than foster systems approaches where innovation emerges from interactions between different types of stakeholder groups across different levels (Schut et al., 2016b).

The results of the ERGMs indicate that, at least in Burundi, there is a clear tendency for organizations that operate at different levels to form a link. This will contribute positively to scaling. The results of the ERGM in Burundi show strong homophily between the same type of organizations, and heterophily when it comes to the administrative level. This indicates a scaling process in which organizations are sharing knowledge that is relevant for their type of organization. Scaling is thus done mostly within the same type of organization because no 'translation' of knowledge is necessary between organizations that use the same type of 'institutional logic' (Smink et al., 2015; Thornton et al., 2012).

3.4.3 Recommendations for policy and further research

This paper provides a first analysis of the early stages of the MSP networks in Burundi, Rwanda and DCR. Continuous mapping of MSP networks over time will enable a longitudinal analysis of network evolution and also link it to actual MSP performance with regard to achieving development impacts.

From the results of this study, we can make some recommendations for the MSPs in the three countries based on their current structural characteristics and deficiencies, combined with insights into the underlying processes that are likely to have influenced the networks' formation. Such insights could be used proactively to think about

innovation network 'architecture' or 'building' to achieve specific types of innovations, innovation processes or scaling pathways (Spielman et al., 2008; Prell et al., 2009; Spielman et al., 2011). In all three countries, this recommendation has to do with the inclusion of more farmer and business representatives within the MSP, to ensure that innovation and scaling is more end-user inclusive. For DRC and Burundi, more attention should be paid to developing the knowledge exchange network in order to connect the different parts of the network (across hierarchies and spatial scales).

3.5 Conclusions

In this chapter, we have explored the potential for innovation and the scaling of innovations of three MSPs for agricultural research and development in Rwanda, DRC and Burundi. A series of propositions and hypotheses based on innovation and scaling literature have guided us in comparing the collaborative, knowledge and influence networks and functions associated with these MSPs in contrasting governance contexts.

With regard to the capacity to innovate, we observed that all three MSP networks are dominated by NGOs, with an apparent lack of business sector involvement. The dominance of development organizations and the lack of entrepreneurial capacity in these networks may hinder social learning and the development of innovations that are commercial and respond to end-user needs. Knowledge plays an important role in the innovation network, and the amount of knowledge exchange is positively correlated with the number of collaborative ties that an organization has within the innovation network. In DRC and Burundi, the decentralized governance structure seems to create a problem, in that MSPs are not strongly linked to the most influential agencies, and this could negatively affect their legitimacy and create obstacles for achieving institutional (policy) innovations and upscaling for impact.

The MSP networks are dominated by supranational and national organizations, whereas local organizations are mostly absent. Such networks are thus less geared towards the outscaling of knowledge intensive innovation and their local adaptation to diverse end-users and environments. The study illustrates that MSP networks are diverse and context-specific. We propose that MSPs should not be used as blueprint vehicles for supporting innovation and scaling, but that more research is required to understand how the institutional setting (e.g. governance) and underrepresentation of certain actors (e.g. private sector) affect the ability of MSPs to stimulate capacity to innovate and achieve development impact at scale.

3.6 Supportive Files

S1 File	https://doi.org/10.1371/journal.pone.0169634.s001
S2 File	https://doi.org/10.1371/journal.pone.0169634.s002
S1 R-scripts	https://doi.org/10.1371/journal.pone.0169634.s003
S1 Table	https://doi.org/10.1371/journal.pone.0169634.s004

3.7 Acknowledgements

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4

Effects of Multi-Stakeholder Platforms on Multi-Stakeholder Innovation Networks

Implications for Research for Development Interventions Targeting Innovations at Scale

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Abstract

Multi-stakeholder platforms (MSPs) have been playing an increasing role in interventions aiming to generate and scale innovations in agricultural systems. However, the contribution of MSPs in achieving innovations and scaling has been varied, and many factors have been reported to be important for their performance. This paper aims to provide evidence on the contribution of MSPs to innovation and scaling by focusing on three developing country cases in Burundi, Democratic Republic of Congo, and Rwanda. Through social network analysis and logistic models, the paper studies the changes in the characteristics of multi-stakeholder innovation networks targeted by MSPs and identifies factors that play significant roles in triggering these changes. The results demonstrate that MSPs do not necessarily expand and decentralize innovation networks but can lead to contraction and centralization in the initial years of implementation. They show that some of the intended next users of interventions with MSPs, e.g. local level actors, left the innovation networks, whereas the lead organization controlling resource allocation in the MSPs substantially increased its centrality. They also indicate that not all the factors of change in innovation networks are country specific. Initial conditions of innovation networks and funding provided by the MSPs are common factors explaining changes in innovation networks across countries and across different network functions. The study argues that investigating multi-stakeholder innovation network characteristics targeted by the MSP using a network approach in early implementation can contribute to better performance in generating and scaling innovations, and that funding can be an effective implementation tool in developing country contexts.

Key words: program, policy, learning system for agricultural research for development (LESARD)

4.1 Introduction

Stakeholder involvement is essential to overcome complex agricultural and environmental problems and achieve development outcomes. Multi-stakeholder platforms (MSPs) are seen as an effective vehicle to support stakeholder involvement in multi-stakeholder processes (Dror et al., 2015; Schut et al., 2016b; Steyaert et al., 2007; van Mierlo and Totin, 2014). For instance, in agricultural innovation systems, MSPs are expected to contribute to creating an enabling environment for technological and institutional innovation, and to facilitate effective up- and out-scaling of these innovations to achieve development impact (Schut et al., 2016b). The increasing popularity of multi-stakeholder and innovation platforms in agriculture and development fields shows optimism about the possibilities for MSPs to foster change and development deliberately and effectively (Sanyang et al., 2015; Schut et al., 2016b). However, bringing together diverse groups of stakeholders in a platform will not automatically lead to innovation or scaling; MSPs have also been reported to fail in delivering their objectives (Faysse, 2006; Merrey, 2013; Warner, 2006a).

MSPs bring together a group of stakeholders working in different sectors. Depending on the issue at stake, these stakeholders can include farmer, private sector, government, research, and extension actors (Homann-Kee Tui et al., 2013). In the course of the MSPs, participating stakeholders, i.e. individuals, groups, and organizations (Warner, 2006a) (hereafter MSP participants), come together and 'get things done' (Röling and Woodhill, 2001a). What is 'done' depends on stakeholders' characteristics such as their capacity and motivation (Greenhalgh et al., 2004) and how they integrate into multi-stakeholder innovation networks (hereafter innovation networks) that give them access to different benefits such as information, markets, and finance (Spielman et al., 2009). Integration into these innovation networks is affected through other stakeholders in these networks, i.e. innovation network stakeholders, and depends on the connections among them (Spielman et al., 2009) both in and outside MSPs. In other words, the characteristics of innovation network stakeholders affect what is done in MSPs and therefore also the MSPs' contributions to innovation and scaling.

The objective of this paper is to investigate the effects of MSPs on innovation networks. We focus on three characteristics – size, connectivity, and configuration of innovation networks to study the changes and explore the factors contributing to these changes. We use three cases, one each from Burundi, Democratic Republic of Congo (henceforth referred to as DRC), and Rwanda, implemented by a CGIAR research program called Integrated Systems for the Humid Tropics (Humidtropics) for more than a year. The paper addresses two research questions: What changes do MSPs trigger

in the characteristics of innovation networks? What other external factors shape the changes triggered by MSPs in innovation networks? The implications for the contributions of MSPs to innovation and scaling without empirical testing are then discussed.

4.2 Concepts, methods, and analysis tools

4.2.1 Empirical framework

Description of MSPs and Humidtropics programme

The MSPs studied in this paper started to be operationalized in Burundi, DRC, and Rwanda in mid-2013. They were initiated in May 2013 in Bukavu, DRC, and in July 2013 in Bujumbura, Burundi, and in Kigali, Rwanda. MSP field-based activities were implemented in Gitega province of Burundi, Ngweshe in DRC, and Kadahenda and Kayonza in Rwanda (Figure 4-1) (Schut et al., 2016c). The MSPs targeted multiple goals: improving income and nutritional status of the poor, improving farm productivity without causing environmental degradation, empowering women and youth, and improving the innovation capacity of agricultural innovation systems. They aimed to optimize the achievement of these goals by investigating and dealing with synergies and trade-offs among the goals.

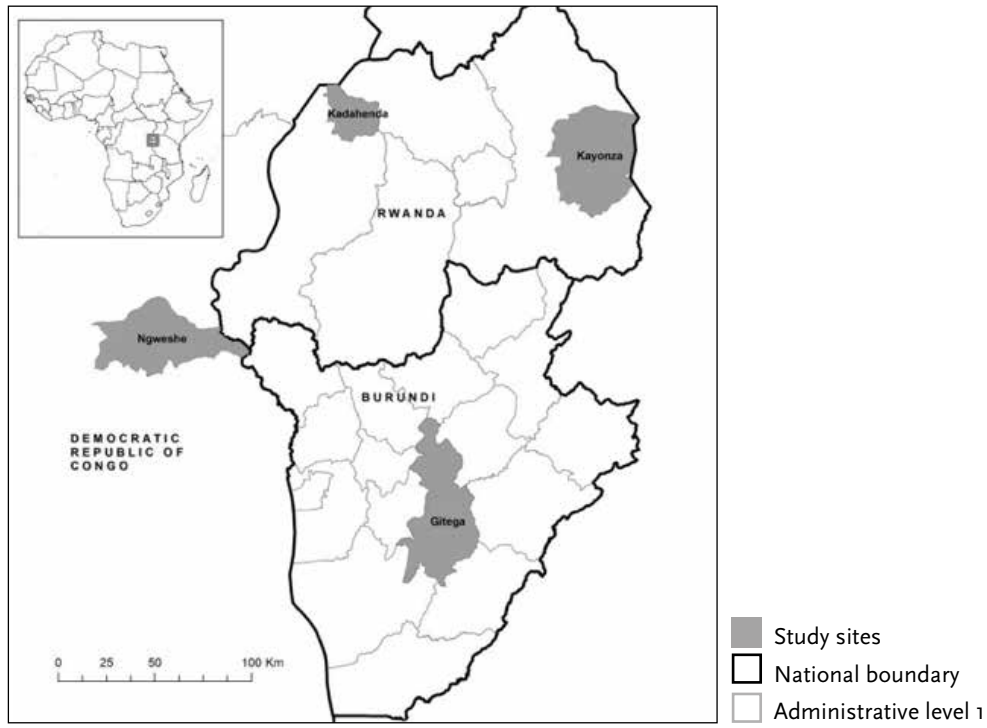
In each country, MSP activities were organized through multiple events in which different numbers and types of stakeholders participated. These events included research events such as setting up, monitoring field trials, and researcher meetings; management events like platform event preparation, sub-groups, and reflection meetings; and other events such as capacity building activities, promotion, and fundraising events for the platform. These events were organized mostly by the lead organization of the Humidtropics programme or in some cases by other MSP participants. The number and sequence of the events varied in each country.

In addition to organizing and funding events, the Humidtropics programme;

- identified MSP facilitators and funded the salaries of these facilitators,
- provided inputs to support some of the activities identified in the MSP,
- funded small research projects prioritized by the MSPs, i.e. platform-led research projects,
- supported or established groups or innovation platforms to better organize activities located in places distant from the capitals (where MSPs events mostly take place),
- managed the administration, monitoring, and evaluation of the small research projects and managed other expenses incurred for the MSPs.
-

Stakeholders were initially selected through a combination of two approaches. The first approach was to send invitations to the representatives of the organizations with which the intervention managers had a long history of collaboration. These included central and local government actors, international organizations, and NGOs specialized in the sector intervention. The second approach was to organize open events and calls to encourage the involvement of stakeholders operating in the target locations. Stakeholders enrolled by these two methods were given the same support in their involvement in the intervention events to minimize the bias of positive selection of stakeholders with a history of collaboration.

Figure 4-1. Operational areas of the multi-stakeholder platforms.



Data collection and cleaning

Data were gathered through written surveys in Burundi, DRC, and Rwanda in August 2014 (t=1) and in October 2015 (t=2). For both surveys (t=1 and t=2), the MSP participants were asked to provide the following information: (1) name, gender, age; (2) all organizations, institutes, companies with which they were affiliated; (3) all organizations in their professional network with which they collaborated; (4) the five organizations from their network that they found to be the most important for knowledge exchange; and (5) the five organizations from their network that they found to be the

most influential (see Support Files 1.1 Survey English t=1). During the second survey, seven questions relating to the functioning of the MSP were added. These included three questions on whether the MSPs had enforced their collaboration, knowledge exchange, and influence spread (ranking agreement on a 5-point scale); two questions on which types and scales of organizations they think more effective in improving capacity to innovate and upscale innovations, i.e. key organizations; and two questions on connections of key organizations among themselves and other influential organizations (see Support Files 1.2 Survey English t=2). The data collected by the initial round of surveys were published in another research paper by Hermans et al. (2017).

Data were entered and cleaned by researchers and the MSP facilitators to enable the matching of organizational abbreviations and full names, to synchronize French and English abbreviations of organization names, and to decipher handwriting and misspelling of names and abbreviations. Where necessary, the organization names were validated through online search.

The accounts of the implementing organization were used to identify the funding allocated to individual organizations and different events. Events organized by the MSPs and the activities targeted by them were identified by using an event-based monitoring and reporting system: learning system for agricultural research for development (LESARD) (Sartas et al., 2017). The coauthors of this paper also attended MSP events. Our participatory observations in these MSP events contributed to our understanding of the data and results.

Data analysis

This paper provides two snapshots of different innovation networks in two different time periods. We used a two-tiered approach in the analysis. Firstly, a social network approach was used to investigate the changes in the size, connectivity, and configuration characteristics of the innovation networks in Burundi, DRC, and Rwanda. Network analysis was used to calculate network statistics for collaboration, knowledge exchange, and influence spread networks using the concepts and measurements presented in Table 4-1. Size and tie information provided by the network statistics was complemented with network maps to further explore the changes in configurations of collaboration, knowledge exchange, and influence spread networks. Network properties were analyzed and visualized using Gephi v.0.9.1 (Bastian et al., 2009).

Secondly, we used logistic regressions to explore statistically the factors that contributed to the changes in the characteristics of the networks. Variables entering the models were selected by forward stepwise selection using a likelihood-ratio test (Sokal and Rohlf, 1969). We explained (1) the dichotomous continuation status of the ties in

Table 4-1. Concepts and measurements in network analysis.

Concept	Mathematical notation	Definition
Graph	G (N, L)	Model for a network with a set of nodes connected by a set of ties
Node	N = [n1, n2, n3, ..., ng]	Organizations depicted in the graph
Tie	L = [l1, l2, l3, ..., lL]	Undirected connection between nodes
Size	G	The number of nodes in the graph
Degree of a node	size of L	The number of ties in a node

the collaboration, knowledge exchange, and influence spread networks at the initial survey, i.e. continue or drop, and (2) the factors that differentiate the characteristics of the ties joining the networks from the ones that were there at both times, using the factors presented in Table 4-2. We used SPSS v.23 for the logistical models.

4.2.2 Conceptual framework

Typology of stakeholders in livelihood and innovation systems based on their involvement in interventions with MSPs

Stakeholders in livelihood systems differ in their involvement with MSPs and with the interventions that MSPs organize. A subset of stakeholders participates in the intervention platform and have a direct chance of influencing the MSP's agenda and events (Table 4-3). A second group of stakeholders are involved in the intervention like the MSP participants but are not involved in the platform. Therefore, they can influence the agenda and events of the intervention but not as directly as the MSP participants. As the second group of stakeholders collaborate with the MSP participants in developing the innovations targeted by the intervention, we refer to the combination of MSP participants and the second group as innovation network stakeholders (Table 4-3). A third group of stakeholders are not involved in the intervention but can influence the impact of the innovation on livelihood systems. They can be collaborating with the stakeholders in the innovation network, or they may be part of a distinct innovation network whose members are connected to the intervention's innovation network (Figure 4-2). As the stakeholders in the innovation network and the third group of stakeholders define the boundaries of the stakeholders who can influence the impact of the innovation on livelihood systems, we define their combination as a new stakeholder group, innovation system stakeholders. Finally, there is a fourth

Table 4-2. Factors and variables used to explore the changes in multi-stakeholder network characteristics.

Factors	Variables	Variable description	Variable values
Institutional environment	Country of operation	The country where the organizations operate, taking a different integer value for Burundi, DRC, and Rwanda	1. Burundi 2. DRC 3. Rwanda
Initial innovation network characteristics	Number of organizations	Number of organizations in the innovation networks	Positive integers
	Number of connections	Number of connections between the same organizations in the existing innovation networks	Positive integers
	Type configuration	A variable taking a different value for each tie	1. Business 2. Farmer 3. NGO/CSO 4. Government 5. Research/Extension/Education
	Scale configuration	A variable taking a different value for each tie	1. District 2. Province 3. National 4. Supranational
Types of problems targeted by MSP	Change in the number	Change in the number of targeted problems in the MSPs, including improving farm productivity, income, nutritional status, environmental degradation, empowering women and youth, and capacity of innovation systems	Integers where each problem theme has the same weight
Funding provided by MSP	To organizations	Amount in US Dollars provided to some selected organizations	Continuous in Dollars
	To events	Share of the events that MSP manager organization fully funded during the MSP (scale)	Percentages
	To collective decisions	A variable for showing provision of platform led-funding (PLF)	0. No PLF 1. Yes PLF
Type of activities (events) in the MSP	Number of events	Number of events recorded by the MSP	Positive integers

Table 4-2. Factors and variables used to explore the changes in multi-stakeholder network characteristics (continued).

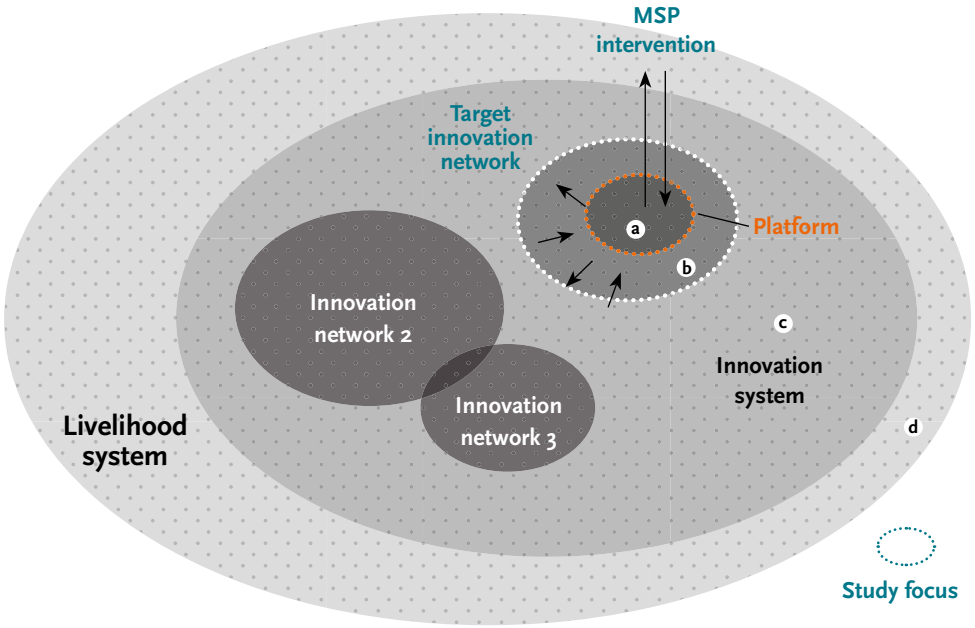
Factors	Variables	Variable description	Variable values
	Share of innovation-generation events	Share of the innovation generation events in the MSP	Percentage
	Share of innovation-diffusion events	Share of the innovation diffusion events in the MSP	Percentage
	Share of innovation-use events	Share of the innovation use events in the MSP	Percentage
	Share of management events	Share of management events in the MSP	Percentage
	Share of process backstopping events	Share of process backstopping events in the MSP	Percentage

Table 4-3. Typology of stakeholders in livelihood and innovation systems based on their involvement in interventions with MSPs and the influence of the intervention on livelihood systems.

Stakeholder group as a whole	Involvement in the intervention with MSP	Involvement in the MSP	Influence on the agenda and events of the intervention with MSP	Influence on the impact of the intervention on livelihood systems
MSP (a)	Yes	Yes	Direct	Direct
Innovation network (b)	Yes	No	Indirect	Direct
Innovation system (c)	No	No	None	Direct
Livelihood system (d)	No	No	None	Indirect

stakeholder group, who are not involved and do not have any influence on the agenda and events of the intervention. Moreover, they do not have any direct influence on the impact of the intervention on livelihood systems. They constitute all the stakeholders in the livelihood system other than the stakeholders in the innovation system.

Figure 4-2. Stakeholders in livelihood and agricultural innovation systems. Dots represent different stakeholders and the circles surrounding them represent the group of stakeholders operating in multi-stakeholder platform (a), innovation network (b), innovation system (c), and livelihood system (d). MSP targets a sub-group of an innovation network (orange circle) with its events and influences, and is influenced by, the characteristics of that network (blue circle).



In terms of stakeholder types based on value-chain functions, MSP participants consisted mostly of researchers in the cases studied. They also included government representatives, technical staff working on targeted innovations, and NGO staff such as farmer representatives working in the locations targeted by the interventions. The innovation networks surrounding the MSP participants included central government actors, UN organizations, and the managers of the organizations' MSP participants, located in bigger cities or in some cases abroad. Provincial and national policymakers and innovation networks organized around other projects were members of the innovation systems in the cases investigated. In almost all the MSPs investigated, there were a few other interventions working on innovations related to the cases on which we focused. Typical examples were interventions focusing on nutrition aspects or marketing aspects of the focus crops in the MSPs studied. Some of the MSP or innovation network stakeholders involved in the cases we investigated were also members of the innovation network of the other interventions (Figure 4-2).

Network-based stakeholder typology, scaling out, and scaling up

The innovation system literature commonly describes the dissemination of the use of innovations among different stakeholder groups as scaling out, whereby innovations developed by livelihood interventions are used in another geographical location (Hermans et al., 2013; Paina and Peters, 2012), or scaling up, whereby innovations are institutionalized and are commonly used at different geographical locations and in different institutional setups (Curry et al., 2013; Franzel et al., 2004; McDonald et al., 2006; Millar and Connell, 2010).

Both definitions are based on geographical location, and scaling up also includes an element of institutional embedding. Spreading the use of innovations from MSPs to outside (Figure 4-2) implies a change in functional stakeholder types, such as from researchers to policymakers, and mostly entails institutional embedding. Therefore, such movements can be considered as scaling up. Spreading an innovation between the same stakeholder type, such as from one innovation network to another, can be considered as scaling out as it does not imply institutional embedding. The network-based typology captures both scaling up and scaling out dimensions of innovation processes (Figure 4-2). In addition, it captures the cases of descaling, where innovations become less used by similar types of actors or the institutional support behind the innovations is lost.

Multi-stakeholder platforms as network interventions

Social networks influence individuals' practices in various aspects of life, including personal and work practices, and they can be leveraged to achieve behavioral and social change. Network interventions are interventions that use the leverage of these social networks purposefully (Valente, 2012) and are shown to improve the dissemination and spreading of innovations (Valente, 2005). Understanding the impact of interventions such as MSPs requires interaction between the actors and their dynamics, i.e. their networks (Hall et al., 2003); and MSPs' aim to enhance an enabling environment for the creation, up-scaling, and out-scaling of innovations (Schut et al., 2016b) requires behavioral and social changes. Therefore, MSPs can be considered as network interventions. Moreover, studying network interventions can contribute to understanding better the complexity and multi-dimensionality of innovation processes (Schneider et al., 2012) and effectiveness factors, and to making better informed decisions about stakeholder strategies (Prell et al., 2008). It also offers governments new opportunities to stimulate agricultural innovation (Beers and Geerling-Eiff, 2014).

Thus, we chose a network intervention approach to study changes triggered by MSPs in innovation networks.

MSP factors affecting characteristics of multi-stakeholder innovation networks across time

The MSP literature reports several performance factors. Firstly, the role of the institutional environment in which innovation networks and MSPs operate has often been found (Schut et al., 2016b; van Mierlo and Totin, 2014) to be a factor that influences how MSP perform. Moreover, funding has been identified as an important performance factor for MSPs (Faysse, 2006; Home and Rump, 2015; Warner, 2006a). A further factor for the performance of multi-stakeholder interventions such as MSPs is the type of problem targeted by them (Borgatti, 2006; Head, 2008). In addition, some types of activities (e.g. entrepreneurial) have been reported to play a role in innovation processes (Hekkert et al., 2007) and influence the performance of MSPs (Hall et al., 2003).

Some other performance factors reported in the literature depend on the initial conditions in the innovation networks. One such factor is the initial strength of the connections (Munoz-Erickson and Cutts, 2016). Another is the type of stakeholder in innovation networks. Participation by farmers, NGOs, research organizations, government actors, and the private sector has been reported to make different contributions to MSP performance (Bebbington and Farrington, 1993; Dror et al., 2015). In addition, the scale at which a stakeholder operates affects the scaling potential of an innovation network in that innovation system (Adekunle and Fatunbi, 2012; Schut et al., 2016b). Therefore, we consider the number of existing organizations and connections, and the change in type and scale of configurations of the innovation networks. In brief, in this paper, we focus on the institutional environment (1) of the country in which the innovation system, the innovation networks, and the MSP operate (2), the number of organizations and strength, type, and scale of existing connections in these innovation networks (3), type of activities in which MSPs engage (4), changes in MSP funding (5), and problems on which MSPs focus (6).

Multi-stakeholder network characteristics influencing innovations and scaling in agricultural innovation systems

A first characteristic of innovation networks that influences innovations and scaling is the size of the network. A bigger innovation network will imply a stronger position vis-a-vis other innovation networks (Smith and Fischlein, 2010), and innovations are considered to have a better outreach if the size of the networks in which they operate is larger (Valente, 2012). A second characteristic reported to be influential in innovations and scaling is the connectivity of the stakeholders in innovation networks. As

the connectivity of innovation networks has been shown to be positively related to the outreach of the innovations and the speed of innovation diffusion (Valente, 2005, 2012), MSPs can be more effective if they trigger an increase in the connectivity of innovation networks. In other words, the size and the connectivity of an innovation network influence the likelihood of successful innovation and scaling.

The characteristics of (1) overall collaboration (Hermans et al., 2013; Home and Rump, 2015), the general category of working together without specification, and two major aspect of collaboration (2) knowledge exchange (Beers and Geerling-Eiff, 2014) and (3) influence spread (Greenhalgh et al., 2004) between stakeholders of innovation networks are considered to play a role in innovation and scaling. In brief, changes in collaboration, knowledge exchange, and influence spread in the innovation networks over the course of MSPs can elucidate the effects of MSPs on innovation and scaling. Therefore, in this paper, we focus on the size and the connectivity of innovation networks in terms of collaboration, knowledge exchange, and influence spread (hereafter innovation network functions). We support the results with network maps to further explore change in the network configurations.

4.3 Results

4.3.1 Characteristics of the Humidtropics multi-stakeholder platforms

The MSPs in Humidtropics were organized in Burundi, DRC, and Rwanda using the same management approach. The Humidtropics programme identified and funded facilitators, provided backstopping for events and innovation platforms, managed MSP administration, and provided funding in all the country cases. However, there were several differences in the MSPs across the countries, such as individual funding provided to individual organizations. Other differences are presented in Table 4-4.

4.3.2 Changes in multi-stakeholder innovation network characteristics

Changes in the characteristics of collaboration, knowledge exchange, and influence spread presented both similarities and differences. In terms of network size and connections, Burundi and Rwanda experienced similar changes, and DRC experienced different ones (Table 4-5). Most of the MSPs (Figure 4-3a) maintained their intermediator role between the organization managing the MSPs and the other stakeholders, which are combinations of national and international organizations (Figure 4-3b). However, some MSPs left the collaboration (Figure 4-3c). In each country, the number of sub-clusters around a single organization decreased substantially. The sub-clusters decreased either because some MSPs dropped out (c) or because of network closure in the innovation network, especially in Rwanda.

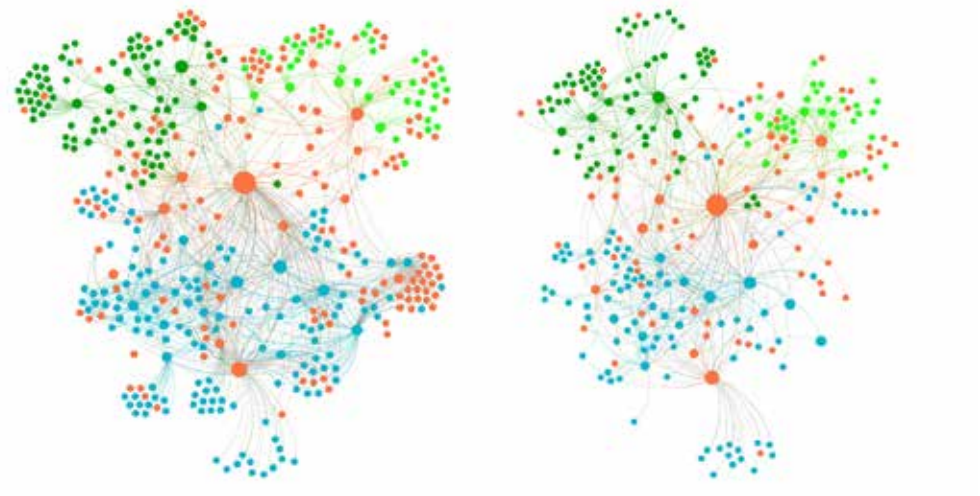
Table 4-4. Differences in MSPs in Burundi, DRC, and Rwanda. Percentages represent the characteristics of the factors between surveys. DRC received the least funding support, and Rwanda received the most. Types of problems targeted by the MSPs increased in Burundi and DRC and stayed the same in Rwanda. Rwanda has the highest number and highest ratio of innovation-generation, innovation-diffusion, and innovation-use events.

	Burundi		DRC		Rwanda	
	T1	T2	T1	T2	T1	T2
Funding for platform-led project	Yes	No	Yes	No	Yes	Yes
Share of events exclusively funded	90%		66%		89%	
Targeting agricultural productivity	Yes	Yes	Yes	Yes	Yes	Yes
Targeting income	No	Yes	No	Yes	No	No
Targeting nutrition	No	Yes	No	Yes	No	No
Targeting gender empowerment	No	Yes	Yes	Yes	No	No
Targeting innovation capacity	No	No	No	No	No	No
Number of events	34		54		99	
Share of innovation-generation events	12%		9%		38%	
Share of innovation-diffusion events	0		0		6%	
Share of innovation-use events	3%		2%		6%	
Share of management events	32%		46%		26%	
Share of process backstopping	44%		20%		19%	

Collaboration networks

Across all three countries, the size of collaboration networks decreased between the observation periods at t1 and t2 (Table 4-5). The highest decrease was observed in DRC with 40%, followed by Rwanda 26% and Burundi 17%. Apart from Rwanda, the number of collaboration connections, or ties, also decreased. Across the countries, multiple ties between the same organizations decreased less than the single ties in the collaboration networks. In Burundi and Rwanda, the number of such multiple ties increased by 184% and 88%, respectively.

Figure 4-3 Maps of multi-stakeholder innovation networks in Burundi, DRC, and Rwanda in t1 (left) and t2 (right). Node size represents the degree centrality. Dark green (upper left) nodes represent organizations based in Burundi, blue (below) represents DRC, light green (upper right) Rwanda, and orange supranational organizations. Dark green colored ties represent organizational connections in Burundi, blue represents DRC, and light green represents Rwanda. Collaboration in innovation networks was positioned around locally central actors (a) in each country and contained sub-clusters with both national and supranational organizations (b). After the MSP, some sub-clusters (c) left the collaboration.



Knowledge exchange networks

Knowledge exchange in Burundi, DRC, and Rwanda experienced different changes in comparison to changes in collaboration. In Burundi and Rwanda, the number of organizations exchanging knowledge increased despite the contraction in collaboration (Table 4-5). The number of organizations exchanging knowledge increased from 31 to 36 in Burundi (nodes with orange ties, Figure 4-4) and from 23 to 25 in Rwanda (nodes with green ties, Figure 4-4). In DRC, the number of organizations exchanging knowledge decreased from 34 to 24. Similarly, knowledge exchange ties and the ratio of multiple ties increased in Burundi and Rwanda but decreased in DRC. However, in all three countries, the ratio of the organizations exchanging knowledge in innovation networks increased, as the contraction of the knowledge exchange was smaller than the collaboration. The ratio of the organizations exchanging knowledge increased from 26% to 36% in Burundi, 14% to 16% in DRC, and 23% to 33% in Rwanda.

Table 4-5. Changes in the collaboration, knowledge exchange, and influence spread characteristics of multi-stakeholder networks in Burundi, DRC, and Rwanda.

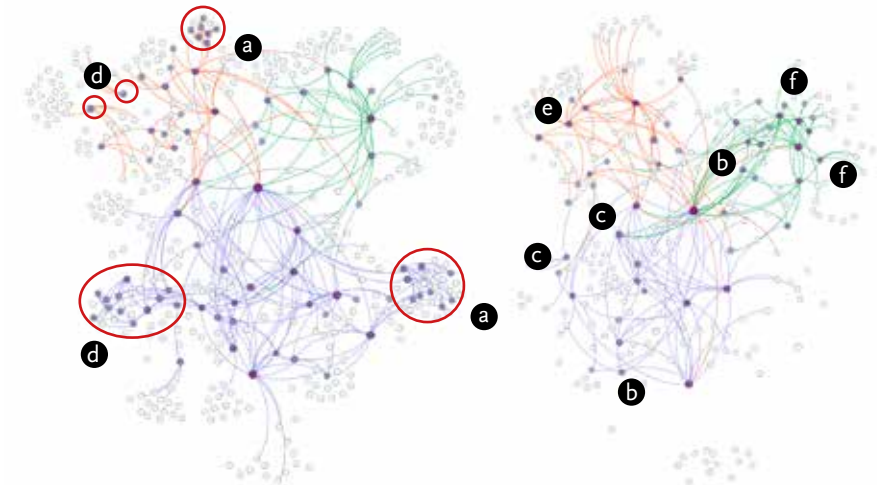
		Burundi			DRC			Rwanda		
		T1	T2	Δ%	T1	T2	Δ%	T1	T2	Δ%
Collaboration	Size	120	100	-17	246	147	-40	103	76	-26
	Ties	202	183	-9	844	314	-63	153	188	23
	With 1	183	129	-30	701	256	-63	27	139	9
	With 2+	19	54	184	143	58	-59	26	49	88
Knowledge exchange	Size	31	36	16	34	24	-29	23	25	9
	Ties	71	77	8	189	69	-63	43	79	84
	With 1	58	60	3	152	60	-61	37	55	49
	With 2+	13	17	31	37	9	-76	6	24	300
Influence spread	Size	27	39	44	41	15	-63	22	21	-5
	Ties	50	83	66	207	51	-75	43	67	56
	With 1	50	64	28	170	47	-72	37	56	51
	With 2+	0	19	N.A.	37	4	-89	6	11	83

Across the countries, the MSPs' managing organization increased its knowledge exchange connections. All knowledge exchange clusters not directly linked to the managing organization (Figure 4-4-a) dropped out in Burundi and DRC. The expansion of the knowledge exchange was attributable to the participation of new national organizations (Figure 4-4-b) as well as to the establishment of cross-boundary connections with organizations operating in the other two countries in the region (Figure 4-4-c). Other changes in the knowledge exchange happened either through existing isolated organizations (Figure 4-4-d) joining the knowledge exchange (Figure 4-4-e) or some new organizations joining the innovation network and the knowledge exchange (Figure 4-4-f).

Influence spread networks

Influence spread networks experienced different changes in the countries. Whereas the number of influential organizations increased in Burundi by 44%, it decreased by 5%

Figure 4-4. Knowledge exchange in innovation networks in Burundi, DRC, and Rwanda in t1 (left) and t2 (right). Node size and boldness represent the degree of knowledge exchange centrality. White nodes are parts of innovation networks but not knowledge exchange. An orange tie color represents connections in Burundi, purple in DRC, and green in Rwanda. During the MSP, all knowledge exchange clusters that were not initially connected to the lead organization (A) left the network. New knowledge exchange connections were generated either by participation of national organizations (B) or by establishing cross-boundary connections (C). Isolated clusters in the initial network (D,E) connected to the main clusters, and some new organizations (F) joined the network.

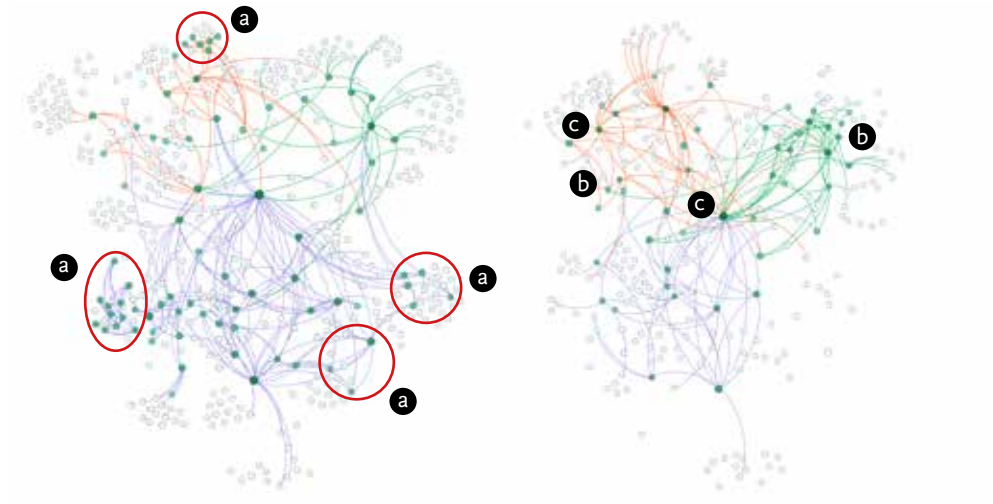


in Rwanda and by 63% in DRC (Table 4-5). Most of the contraction in Burundi and DRC was attributable to the disappearance of some influence clusters (Figure 4-5-a). An increase in the MSP managing organization's influence ties (Figure 4-5-c) was the major driver of the increases in mean degree of influence in Burundi and Rwanda. In Burundi and Rwanda, the participation of small groups (Figure 4-5-b) of influential organizations in the innovation networks and, in Burundi, the increase in the influence ties of some organizations (Figure 4-5-c) supported the major driver. However, no such continuing influential organization was observed in DRC.

4.3.3 Factors influencing multi-stakeholder innovation network characteristics

Factors explaining the changes in the configurations of the collaboration, knowledge exchange, and influence spread networks differed in terms of the two major changes observed: i) incumbent stakeholders leaving and ii) new stakeholders joining the networks (Table 4-6). For both, correctly predicted percentages were more than 80%.

Figure 4-5. Influence spread in innovation networks in Burundi, DRC, and Rwanda in t1 (left) and t2 (right). Node size and boldness represents the degree of influence centrality. White nodes are parts of innovation networks but not influential. An orange tie color represents connections in Burundi, dark blue in DRC, and green in Rwanda. During the MSP, some existing influence clusters (A) left the networks, some organization (B) joined the influence spread networks, and some existing organizations (C) increased their influence.



4.4 Analysis and discussion

4.4.1 Common changes in multi-stakeholder innovation networks

Our study indicated two major common aspects of change in innovation networks following MSPs: heterogeneity of change in innovation network functions and centralization of innovation networks. Our results showed that the changes in size and connectivity depended on the specific innovation functions. Whereas network size and the number of ties decreased in collaboration networks, they increased in knowledge exchange and influence spread networks (Table 4-5). Moreover, the changes in collaboration varied more not only across countries, but also in terms of factors that play a significant role in the changes. Changes had higher variability across countries, and the number of significant factors was higher in collaboration networks than in knowledge exchange and influence spread networks (Table 4-6). This confirms the distinction suggested by the literature on agricultural innovation systems (Beers and Geerling-Eiff, 2014; Hermans et al., 2013) as well as other sectorial innovation systems (Greenhalgh et al., 2004; Larsen, 2011) between the changes in different functions fulfilled by innovation networks.

Secondly, our data show that MSPs did not necessarily lead to decentralized networks where different innovation network stakeholders have high collaboration, knowledge exchange, and influence connections. On the contrary, the MSPs' lead organization (represented by the largest node in Figure 4-3) increased its knowledge exchange (Figure 4-4) and influence centrality (Figure 4-5), whereas the majority of the other influential and central knowledge exchange organizations disappeared from the innovation networks (Figures 4-4 and 4-5). Although a central position for the MSPs' lead organizations is neither rare nor necessarily problematic (Head, 2008), it indicates that their point of view will be more represented in the networks (Holman, 2008), and the needs and participation of some stakeholders will be undermined (Hall et al., 2003). This is a risk for innovation and scaling, as the influence of MSPs' lead organizations can disrupt the existing networks, can outcompete other organizations from the networks (Steins and Edwards, 1999), and create a situation where stakeholders are willing to collaborate with the lead but not with one another (Home and Rump, 2015). In our cases, outcompeting was evident in all networks (Figures 4.3 to 4.5) apart from those in Rwanda. Moreover, the increasing connectivity of the lead organization was not accompanied by increasing connectivity of other innovation network stakeholders, again apart from Rwanda, indicating an increasing willingness to collaborate with the lead but not with one another. In brief, centralization occurred in all three countries in terms of all network functions, but the risks of outcompeting and preference for connectivity to the lead depended on the case.

4.4.2 Function-specific changes in multi-stakeholder innovation networks

The data from the Humidtropics programme in Burundi, DRC, and Rwanda indicate that the MSPs did not increase the collaboration in innovation networks (Table 4-6) during the period of our investigation. On the contrary, the number of organizations collaborating in the innovation networks and the connections between them decreased in all three countries (Table 4-5). This supports the argument that organizing MSPs does not automatically lead to more collaborative participation (Faysse, 2006; Merrey, 2013; Warner, 2006a). Despite the decreases in collaboration network size and number of ties in Burundi and Rwanda, knowledge exchange network size and number of ties increased (Table 4-5). Our data indicate that the drivers of the increase were (1) participation of new organizations in knowledge exchange (Figure 4-4) especially through the establishment of regional knowledge linkages with other countries in the region (Figure 4-4) and (2) increasing knowledge integration of separate knowledge exchange clusters into main knowledge exchange group (Figure 4-4). These data confirm that the MSPs coincided with increasing expectations from several isolated organizations (Valente, 2012), triggering their participation. However, at the same time, all existing sub-knowledge clusters connected to the main knowledge exchange networks in Burundi and DRC in the initial data collection period disappeared (Figure

Table 4-6. Changes in the collaboration, knowledge exchange and influence spread characteristics of multi-stakeholder networks in Burundi, DRC, and Rwanda.

Factors and variables		Incumbents staying (Leave: 0, Continue: 1)						New stakeholders joining (Incumbent: 0, New: 1)					
		Collaboration		Knowledge exchange		Influence spread		Collaboration		Knowledge exchange		Influence spread	
		Exp (β)	Wald	Exp (β)	Wald	Exp (β)	Wald	Exp (β)	Wald	Exp (β)	Wald	Exp (β)	Wald
Innovation network characteristics	Number of organizations at t1			.85+	23.9	.93+	74.9						
	Number of connections at t1	3.8+	54	2.64+	9.6			.47+	41.3	.17+	22.9	.28+	19.9
	Type configuration												
	Business	2.4*	4.9										
	Government	2.1+	6.9					.5+	9.7				
	NGO	1.9+	5.9							.4*	4.1		
	Research	2.7+	8.3							.2+	9.4		
	Scale configuration												
	District	.18+	11.11										
	Provincial	.54+	4.73			.3*	4.3						
Funding provided by MSP	To organizations	1+	13.3	1+	6.3	1.1+	7.7						
	To events	.01+	71.7					38.5+	43.6	196+	52	47.8+	53
Types of problems targeted by MSP	Change in the number	.63+	11.1					1.4*	6				
Model statistics	Log likelihood	681		194		170		555		173		161	
	Cox Snell R square	.56		.53		.56		.44		.46		.44	
	Nagelkerke R square	.75		.70		.75		.58		.62		.59	
Hosmer and Lemeshow test	Chi-square	4.7		3.2		.65		7.2		5.5		4.9	
	df	8		5		3		8		8		3	
	Significance	.79		.66		.89		.51		.70		.18	
Predicted	Correct percentage	89.2		88.8		89.7		81.9		85.3		84.6	

(*) and (+) Denote significance levels for individual factors at 0.05 and 0.01. Country of operation and number of problems targeted at t1 were not significant in any of the innovation networks. Farmers belonging to type configuration and national and supranational organizations in scale composition were not significant for any innovation networks. None of the event variables, i.e. number of events, share of innovation generation, diffusion and use events, aggregation of all innovation events, management or backstopping events, was significant. As platform-led small research was provided only to Rwanda at t2, the variable was highly correlated with country and it was dropped from the models.

4-4). Thus, it can be argued that loosely connected knowledge exchange networks with local clusters can result in competitive behavior in the knowledge exchange network, forcing some organizations out. However, once the competitive clusters are out, innovation networks can start building higher connectivity through network closure (Giuliani, 2013); this was visible especially in Rwanda, where no initial knowledge cluster was not connected to the MSP's managing organization (Figure 4-4). These changes imply that interventions disrupt existing knowledge exchange networks and create 'winners' and 'losers' in terms of innovation actors' connectivity in the areas targeted. Change in the influence spread networks' size and number of influence connections was case specific. Except in Burundi, influence spread network size decreased. Downward pressure on the influence spread networks attributable to the disappearance of some influence clusters (Figure 4-5) was mitigated by the participation of new influential organizations (Figure 4-5) and the increasing influence size of the managing organization (Figure 4-5). In Burundi, the number of influential participants was sufficient to substitute the decrease, but not in DRC and Rwanda.

4.4.3 Common significant factors of change in multi-stakeholder innovation networks triggered by multi-stakeholder platforms

Our study showed that initial innovation network characteristics and funding provided by the MSP had significant roles in explaining the decisions of the innovation network stakeholders to continue in the networks and in explaining the difference between the continuing group of stakeholders and the stakeholders joining the innovation networks in terms of all functions (Table 4-5).

In our study, the number of connections at the initial survey was a significant factor explaining the changes in the innovation networks (Table 4-6). The likelihood of a connection between two organizations staying in the innovation networks increased significantly a s the number of connections between these organizations increased in the initial period. Moreover, the number of new connections between two organizations was lower than the number of existing connections in the collaboration, knowledge exchange, and influence spread networks. In other words, in the period of our study, connections between two organizations persisted more if they were connected in multiple channels, and it took time to increase the number of connections when they were new in the innovation networks. Moreover, in our study, none of the event factors, i.e. number of events, number of specific event types, or share of event types, was significant, despite the variability across the countries (Table 4-4). Time could be a possible reason for the insignificant results, given that the effects of MSP activities involving research processes are reported to show their effects only after a time lag (Aw-Hassan, 2008; Head, 2008; Lilja and Dixon, 2008; Zornes et al., 2016). In brief, our study confirms that changes triggered by MSPs happen slowly, as commonly recognized in the MSP and innovation systems literature (Hermans et al., 2015; Roloff, 2008; Sanginga et al., 2007; Triomphe et al., 2013).

The data in our study indicate that country was not a significant factor in explaining changes in innovation network functions in our cases. As the institutional context surrounding innovation networks has been shown to play a role in the effects triggered by MSPs (Malinsky and Lubelsky, 2011; Schut et al., 2016a; Zornes et al., 2016), insignificant country variation implies that the role of the institutional environment was reflected through other significant factors in our models: initial innovation network characteristics, funding provided, and type of activities targeted by MSPs (Table 4-6). Of these factors, decisions on funding and type of activities targeted by MSPs are less likely to be influenced by the specifics of the institutional environment, as in our three cases the managing organization had the dominant role in making funding and activity decisions. Thus, in our cases, initial innovation network characteristics have a high chance of sufficiently representing the effects of the institutional environment on changes triggered by MSPs.

Our data show that the likelihood of staying in all three networks increased if the organization received direct funding. Moreover, the likelihood of new collaboration, knowledge exchange, and influence connections increased significantly as the share of events funded by the MSP increased (Table 4-6). As limited resources cannot satisfy an increasing number of stakeholders in innovation networks (Warner, 2006a), the fact that funding is a significant aspect implies that the number of stakeholders that can be financially incentivized is also limited. The decrease in network size and the number of connections in collaboration networks, which were relatively higher initially, combined with increasing network size and number of connections in knowledge exchange and influence spread networks, which were relatively lower in the beginning (Table 4-5), supports the existence of limitations introduced by funding in our cases. In addition, the data show that MSP events were highly dependent on the funding provided by MSPs (Table 4-6). For instance, at least two thirds of the events were fully funded by the MSPs. Dependency on funding has been reported to be high, especially in developing countries where organizations are forced to prioritize funding (Bebbington and Farrington, 1993), and the number of opportunistic organizations is high in relation to the size of innovation systems (Spielman et al., 2009). In our study, all three cases are developing countries. In brief, our cases support the assertion that, in developing countries, funding dependency and opportunistic behavior by organizations limit MSPs' ability to affect innovation networks.

4.4.4 Function-specific significant factors of change in multi-stakeholder innovation networks triggered by multi-stakeholder platforms

In terms of the decision to stay in the collaboration networks, multiple factors were significant. In addition to the initial characteristics of the innovation networks, number of initial connections, type and scale configuration of stakeholders, funding provided to organizations directly and to events, and type of activities undertaken by the MSP were all significant (Table 4-6).Multiple significant factors might suggest that stakeholders make their collaboration decisions based on different purposes such as access to information, knowledge, and capacity development (Head, 2008; Zornes et al., 2016).

Among the factors, share of events funded by the MSP has the largest effect. The likelihood of staying in innovation networks decreased dramatically as share of the events funded by the MSP increased. This confirms our previous statements on the importance of funding and dependency on funding to stay in the networks. As MSPs have limited resources, higher dependency on MSP funding for events implies less room for an organization to benefit financially from such events. When funding is important for the participating organizations, having less room for financial benefits leads to a lower likelihood of staying.

An increase in the number of types of activities decreased the likelihood of continuing and increased the likelihood of new connections in collaboration. When the first survey was administered, the priority was agronomy work through implementing activities on the ground (Table 4-4). It was considered that showing tangible activities would attract the interest of farmers and governments, help show progress to donors, and prevent interventions appearing to be 'talking clubs'. Thus, field activities, which present activities on the ground, were operationalized, and field trials were established in many project locations. When the second survey was conducted, other goals such as improvement in nutritional status (in Burundi and DRC) and capacity building in gender issues (in Burundi) started to be implemented (Table 4-4). As farmer organizations are less involved with the provision of new types of activities such as nutrition and gender work, targeting nutrition and gender and implementing related activities coincided with the decreasing likelihood of farmer organizations staying in comparison to other types of innovation network stakeholders. Moreover, the relative participation of NGOs in Burundi and DRC, where they are the major providers of nutrition and gender work, increased. In brief, as the diversity of the activities increased, new stakeholders engaged in the new activities – NGOs – joined the networks, and there was a decrease in the likelihood of farmers staying in the networks, even though these had been very involved with initial activities.

Change, in terms of thematic focus, in the configuration of the innovation networks implies that thematic diversity of the objectives of the intervention is an important factor to consider in utilizing MSPs in interventions aiming to scale innovations. If the scaling of the target innovation depends on improving conditions cutting across different themes, a more in-

Table 4-7. Changes in innovation networks, factors influencing the changes, and the implications for scaling innovations following an R4D *intervention with MSPs.*

		Changes	Factor	Implications for scaling
General		Changes in innovation networks depend on functions	Initial network characteristics have a high influence on the changes	Influence of the intervention on scaling depends on the functional needs of the targeted innovation and the initial configuration of innovation function networks.
		Innovation networks can centralize and outcompete existing central actors	Funding is a significant factor for the changes	The interventions need to consider out-competition risk. Provision of funding is a major source of competition introduced by the intervention.
Functions	Collaboration	Extent and density of collaboration does not increase	Collaboration depends on a greater variety of factors than specific functions	The intervention might be ineffective in scaling innovation if innovation requires extensive or intense collaboration because of the diverse nature of collaboration in innovation networks.
	Knowledge exchange	Extent and density of knowledge exchange might increase or decrease Existing knowledge clusters can leave the network	1. Participation of new knowledge actors 2. Integration of small and loosely connected clusters into the main cluster 3. Funding is a significant factor 4. Type of organization is a significant factor	The intervention disrupts existing knowledge networks, creates winners and losers mostly determined by the funds provided by the intervention and is influenced by type of stakeholder to a lesser extent. It can negatively influence scaling if there is already a knowledge cluster focused on the targeted innovation and funding of the intervention is not provided to the organizations in existing clusters.
	Influence	Extent and density of influence spread might increase or decrease Existing influence clusters can leave the network	1. Participation of new influential actors 2. Funding is a significant factor 3. Influence clusters leave the network	The intervention disrupts existing influence networks, creates winners and losers mostly because of funds provided by the intervention. It can negatively influence scaling if there is already an influence cluster focused on the targeted innovation.

tense monitoring and a more adaptive stakeholder involvement facilitation approach might be necessary in comparison to what might be required for scaling innovations that have a narrow thematic focus.

Significant factors explaining the changes in knowledge exchange and influence spread networks were fewer in number in comparison with those for collaboration networks. This confirms that collaboration networks reflect a greater diversity of participation purposes than knowledge exchange and influence spread networks. In the latter networks, in addition to the previously discussed factors (initial number of connections, funding provided to specific organizations and to events), the number of organizations in the innovation networks was initially high. As the number of organizations increased, the likelihood of organizations staying in knowledge exchange and influence spread networks decreased. Table 4-7 provides an overview of the changes, factors, and implications of using MSP interventions to scale innovation.

4.5 Conclusions

We have confirmed that MSPs do not necessarily increase stakeholders' participation and connectivity in innovation networks in the first few years of implementation. In addition, MSPs do not necessarily result in decentralized innovation networks. Using a participatory approach in the MSPs does not prevent centralization of innovation networks around a central actor that dominates some network functions. Although centralization does not necessarily inhibit innovation and scaling, as shown by some of our cases, it can introduce risks for innovation and scaling by crowding out some important stakeholders. Monitoring the process of change in the characteristics of innovation networks can help to identify this risk carried by MSPs.

We have shown that the influence of MSPs with the same approach to participation, connectivity, and configuration characteristics of innovations can be different. The changes in these three characteristics differ not only among the three countries studied, but also among different innovation network functions. This supports the contextual character of MSP influence on innovation networks. However, our study has also shown that there are common factors that influence the innovation network characteristics in the same manner across countries and functions, such as initial network characteristics and funding.
Initial network characteristics, especially the number of existing connections in innovation networks, were significant factors for the changes in the innovation network characteristics across all three cases. Moreover, all the innovation networks in our cases presented a high degree of continuity in many characteristics. In addition, we

have shown that the influence of the case-specific institutional environment on innovation networks can be sufficiently captured by initial network characteristics. Thus, investigating innovation network characteristics using a network approach in the early phases of MSPs can contribute to MSP performance in improving innovation and scaling by capturing the effect of contextual characteristics and identifying target organizations and connections among innovation networks. Financial incentivizing of organizations, either directly or indirectly through events, can be an effective tool for MSPs to influence the change in innovation networks towards better innovation and scaling.

We should, however, acknowledge that, although the MSPs studied used the same approach and were managed by the same organization, heterogeneities can occur, as commonly observed in complex interventions. Further exploration of the heterogeneities of MSPs could improve our study's conclusions. We also anticipate a difference in the speed of change in innovation networks in different countries and for different functions. As our data did not capture a long period and time was a factor in the changes in the innovation networks, a better understanding of the phases of the innovation networks can shed further light on changes triggered by an MSP in innovation networks.

4.6 Acknowledgement

This work was carried out under the framework of the Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA), which is funded by the Belgian Directorate General for Development Cooperation and Humanitarian Aid (DGD). CIALCA forms part of the CGIAR Research Program on Integrated Systems for the Humid Tropics (Humidtropics), and the CGIAR Research Program on Roots, Tubers and Bananas (RTB). We would like to acknowledge Humidtropics, RTB, and the CGIAR fund donors (www.cgiar.org/about-us/governing-2010-june-2016/cgiar-fund/fund-donors-2) for their provision of core funding without which this research would not have been possible. The authors highly appreciate all multi-stakeholder platform facilitators and members who collaborated with us and provided the data and insights necessary for this study.

4.7 Support Files

Support Files 1.1 Survey English t=1
Name:
Gender: Male/ Female
Age:
Organizations you represent:

List all organizations you collaborate with:

Support Files 1.1 Survey English t=2
Name:
Gender: Male/ Female
Age:
Organisations you represent:
List all organizations you collaborate with:

Additional questions
In the last year, the R4D platform has enforced collaboration between your organization and other partners (please circle appropriate).
- o I strongly disagree
- o I disagree
- o Neutral
- o I agree
- o I strongly agree

In the last year, the R4D platform has enforced exchange of knowledge between your organization and other partners (please circle appropriate answer).
- o I strongly disagree
- o I disagree
- o Neutral
- o I agree
- o I strongly agree

In the last year, the R4D platform has allowed your organization and others to influence policymakers (please circle appropriate answer).
- o I strongly disagree

- o I disagree
- o Neutral
- o I agree
- o I strongly agree

In your opinion, what is necessary for the R4D platform to improve in terms of reinforcement of collaboration, exchange of information and influence on policymakers?

Write your answer here:

Support Files 1.1 Survey English t=2
Name:
Gender: Male/ Female
Age:
Organisations you represent:

List all organizations you collaborate with:

Additional questions
In the last year, the R4D platform has enforced collaboration between your organization and other partners (please circle appropriate) :
- o I strongly disagree
- o I disagree
- o Neutral
- o I agree
- o I strongly agree

In the last year, the R4D platform has enforced exchange of knowledge between your organization and other partners (please circle appropriate answer) :
- o I strongly disagree
- o I disagree
- o Neutral
- o I agree
- o I strongly agree

In the last year, the R4D platform has allowed your organization and others to influence policymakers (please circle appropriate answer) :

- o I strongly disagree
- o I disagree
- o Neutral
- o I agree
- o I strongly agree

In your opinion, what is necessary for the R4D platform to improve in terms of reinforcement of collaboration, exchange of information, and influence on policymakers ?

Write your answer here :

Continue here:

Local (village, district)
Provincial
National
Supranational

6. Which types of organizations are more effective in improving capacity of innovation in the agricultural and food sectors? Please choose maximum 2 for each group.

Farmer Organizations	
NGO or CSO	
Business	
Researchers or universities	
Government	
Others	

7. Which linkages are more effective in scaling innovations in the agricultural and food sectors? Please mark the 3 most important boxes. The linkages can be both between both different groups and the same groups.

	Local	Provincial	National	Supra national
Local (village, district)				
Provincial				
National				
Supranational				

8. Which linkages are more effective in scaling innovations in the agricultural and food sectors? Please mark the most important box.

	Farmer	NGO/CSO	Business	Academy	Govern-ment
Farmer Organizations (Farmer)					
NGO or CSO					
Business					
Academy (Researchers or universities)					
Government					

5

Measuring the Performance of Multi-Stakeholder Platforms in Research for Development

Lessons from Central and Eastern Africa

Submitted for Publication in PLOS One:
Sartas, M., Schut, M., van Asten, P., Tenywa, M., Hicintuka, C., Mapatano, S., Muchunguzi, P., Okafor, C., Vanlauwe, B., Thiele, G., and Leeuwis, C. (2018). Measuring the Performance of Multi-Stakeholder Platforms in Research for Development: Lessons from Central and East Africa. PloS one, PONE-S-18-11657

Abstract

Multi-stakeholder platforms (MSPs) such as learning alliances, public–private partnerships, and innovation platforms have been utilized commonly in recent research for development (R4D) interventions aiming to improve innovation and livelihood systems. Many studies have concluded that MSPs' contribution to R4D performance is influenced by dynamic drivers. However, hardly any studies have systematically explored these performance drivers and the factors influencing their dynamics using a metric approach. This paper focuses on 'how' MSPs influence the performance of R4D interventions in terms of achieving livelihood impacts. It investigates the dynamics of four performance drivers – participation, shared understanding, engagement, and learning – using 10 cases operationalized in Burundi, Democratic Republic of Congo, Rwanda, and Uganda between 2013 and 2017. The paper also explores the contextual and intervention-related factors that influence the dynamics of the performance drivers, i.e. the duration of the intervention, the specific country in which the R4D intervention was implemented, the location of the events along a rural–urban gradient, the share of funding provided to R4D events by the organization managing the intervention, and the type of R4D event. The paper uses a mixed-methods approach in which a text analysis method is used to generate quantitative indicators that are used to conduct trend and correlation analysis. The results show that participation, shared understanding, engagement, and learning in R4D events do not evolve linearly but follow cyclical trajectories. In addition, each of these four performance drivers has different dynamics and is influenced by different contextual and intervention-related factors. Participation was significantly higher in more rural settings, and shared understanding and learning were significantly related to time.

5.1 Introduction

Multi-stakeholder platforms (MSPs) have been used in diverse research for development (R4D) interventions (hereafter interventions) such as policy, programs, and projects to enhance the interventions' performance. Over the past decade, MSPs have been used to mobilize diverse stakeholders to identify and analyze problems, and to design and implement R4D activities to overcome these problems. Although MSPs are 'branded' differently – as multi-level community partnerships (Kozica et al., 2016; Dickson-Gomez et al., 2016), public–private partnerships (Eggersdorfer and Bird, 2016; Yildirim et al., 2016; Abbott, 2012), multi-stakeholder partnerships (Biermann et al., 2007; Kefasi et al., 2011), multi-stakeholder platforms (Huang et al., 2017; de-Zeeuw, 2010; Thiele et al., 2011), innovation platforms (Kilelu et al., 2013; Schut et al., 2016b; Hermans et al., 2017; King et al., 2010), and learning alliances (Verhagen et al., 2008; Douthwaite et al., 2003) – they are all used to facilitate the involvement of different stakeholders in interventions, thereby enhancing the impact of the interventions on livelihoods.

Studies have argued that MSPs can play different roles in R4Ds interventions. Whereas some studies argue that MSPs can basically be used to achieve a broad variety of R4D objectives (Kefasi et al., 2011; Adekunle and Fatunbi, 2012; Akpo et al., 2014; Joy et al., 2008), others are more restrictive about what types of R4D objectives MSPs can and cannot achieve (Warner, 2007; Faysse, 2006; Schut et al., 2016a). Despite the different opinions about MSPs' contribution, the majority of MSP studies recognize the dynamic nature of MSPs (Dickson-Gomez et al., 2016; Kilelu et al., 2013; Sanginga et al., 2007; Alsop and Farrington, 1998; Neef and Neubert, 2011; Eriksson et al., 2014) and argue that understanding these dynamics can enhance MSPs' contribution to the performance of interventions and their impacts on innovation and livelihood systems. However, the majority of the studies are exclusively qualitative and do not provide information on dynamics. Moreover, few studies make a systematic comparison of the contextual factors that contribute to the observed dynamics.

This study aims to enrich the literature by exploring the four performance drivers of MSPs through the investigation of the continuous temporal dynamics and through the systematic comparison of the contextual and intervention factors that contribute to these dynamics. It investigates participation, shared understanding, engagement, and learning in a series of R4D events such as meetings, workshops, training sessions, field visits. It uses data collected from 10 different MSPs in Burundi, Democratic Republic of Congo (DR Congo), Rwanda, and Uganda under the CGIAR Research Program on Integrated Systems for the Humid Tropics (Humidtropics) between 2013 and 2017. The study address three research questions: (1) Are participation, shared

understanding, engagement, and learning in R4D events as dynamic and diverse as suggested by the literature? (2) Can the dynamics and patterns be explained by contextual factors, including country and location of operation, or intervention-related factors, i.e. funding mechanisms, human resources used to implement the MSPs, and type of R4D event? (3) Are there any periods when participation, shared understanding, engagement, and learning can present a similar pattern? Addressing these three questions supports reflection on how key performance drivers might contribute to improving the performance of interventions organized through MSPs.

5.2 Conceptual and methodological framework

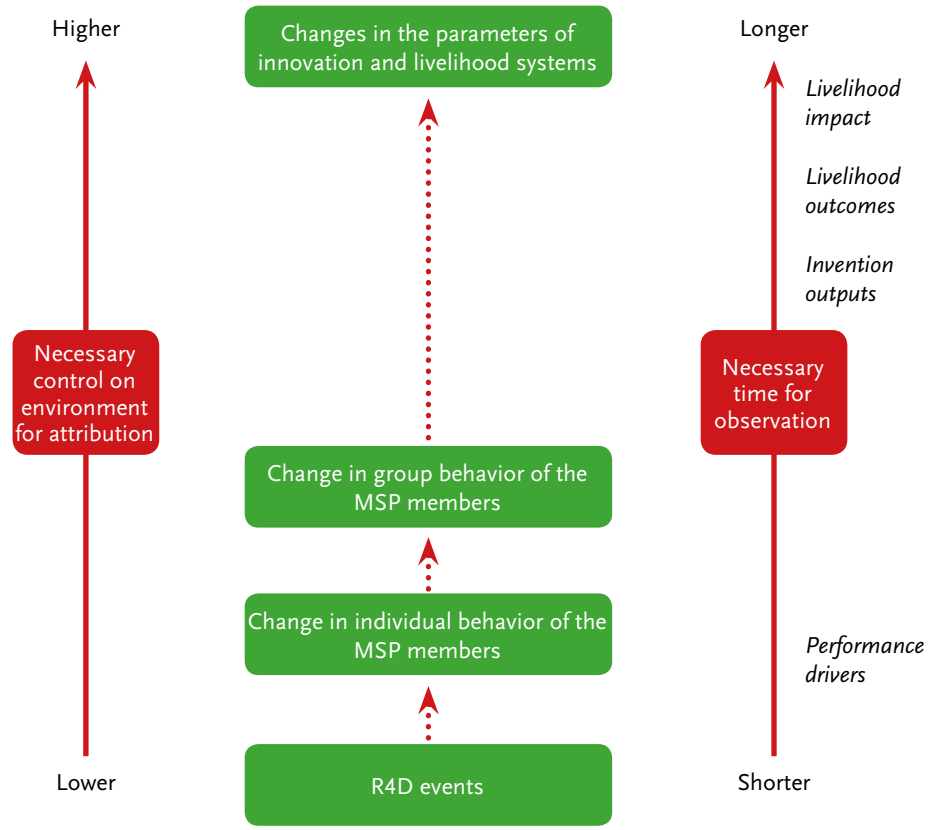
5.2.1 The role of MSPs in improving the impact of interventions

The scientific literature includes many studies that explore the contribution of MSPs to the performance of interventions. Whereas some focus on performance changes in terms of intervention outputs (Franzel et al., 2004; Moore and Westley, 2011), others focus on changes in terms of livelihood outcomes (Faysse, 2006; Failing et al., 2004) and livelihood impact (Pamuk, 2014; Greenhalgh, 2015; Berger, 2006). Assessing performance changes in terms of livelihood impact and outcomes requires a long-term scope (i.e. five years) and a controlled research design approach (Figure 5-1). Although very informative, the results of such assessments often become available well after the operational lifetime of most interventions. In addition, most intervention outputs are completed in the last phase of interventions. In other words, the assessment of the performance change comes too late for the adaptive management of the MSP. However, alternatively, it is possible to measure the changes in some drivers that elucidate the performance of the interventions organized by MSPs (hereafter performance drivers) that can be observed in a relatively short time and be attributed to the MSPs by using a systematic approach with quantitative elements such as the learning system for agricultural research for development (LESARD) (Sartas et al., 2017).

5.2.2 The performance drivers of interventions with MSPs

Literature on interventions focuses on three major intervention types. The first type is projects, which are sets of activities with clear objectives and time scopes. Projects are the commonest way of organizing actions aiming to improve innovation and livelihood systems. The second major type is programs, which is a portfolio of related projects. The third major intervention type is policy interventions that aim to change legislation and the practices followed by governments. The literature studying the performance drivers for these three types of interventions suggests a broad set of performance drivers when interventions are organized through MSPs (Table 5-1).

Figure 5-1. Theory of change for studying the contribution of MSPs to R4D performance.



Of the eight performance drivers mentioned in Table 5-1, four of them, participation, shared understanding, engagement, and learning, cut across a variety of interventions (e.g. policy, program, and project) and livelihood aspects (e.g. agriculture, environment, health, and income) and thus have the largest applicability in interventions. We therefore decided to focus on these four performance drivers (hereafter key performance drivers) in our study.

The basic definition of participation refers to the attendance of (different groups of) stakeholders at R4D events. However, other studies define participation in a broader way – for example including aspects such as active influence on the MSP agenda (Leeuwis, 2000; Reed et al., 2010), being vocal during events (Bendell, 2005), and provision of resources to the intervention (Hale and Mauzerall, 2004). As the broader definition of participation partially overlaps with other key performance drivers and as

Table 5-1. An overview of performance drivers of interventions with MSP.

Drivers	Type of inter-vention	Targeted livelihood domain	Literature examples
Transparency	Policy	Environment	Hale and Mauzerall,2004; Rothenberger et al., 2005;
Consultation	Policy	Agriculture	Kefasi et al. 2011;
Participation	Policy, program, project	Environment, income, agriculture, health	Kozica et al., 2016; Hale and Mauzerall,2004; Evans et al. 2009; Richardson and Grose (2013);
Shared understanding	Policy, program, project	Environment, income, agriculture, health	Kefasi et al. 2011; Adekunle and Fatunbi, 2012; Hale and Mauzerall,2004; Richardson and Grose, 2013; Gupta, 2014. Klerkx et al., 2012;
Learning	Policy, program, project	Environment, income, agriculture, health	Kilelu et al., 2013; Eriksson et al., 2014; Hale and Mauzer-all,2004; Richardson and Grose 2013; Evans et al. 2009
Engagement	Policy, program, project	Environment, income, agriculture, health	Abbott, 2012; Rothenberger et al., 2005; Blignault et al. 2016; Evans et al. 2009; Eriksson et al. 2014
Negotiation	Policy, project	Agriculture	Kefasi et al. 2011; Kilelu et al., 2013; Giller et al., 2008
Institutional-ization	Policy, project	Environment, agriculture	Hale and Mauzerall,2004; Evans et al. 2009

using a more comprehensive definition makes quantification more complex, we use the basic definition, which is more common in the R4D literature, more exclusive of other key performance drivers, and more easily quantifiable.

Shared understanding refers to convergence of MSP participants' perspectives. In the R4D literature, the convergence process is called common visioning (Faysse, 2006; Warner, 2006b), shared understanding (Roloff, 2008), and joint prioritization (Haemaelaeinen et al., 2001; Baeckstrand, 2006). Different dimensions of convergence are captured, including those relating to objectives (Roloff, 2008; Devaux et al., 2009), actions necessary to achieve these objectives (Adekunle and Fatunbi, 2012), and innovations that fit best given the objectives (Adekunle and Fatunbi, 2012; Tenywa et al., 2012). In this paper, the convergence of (1) the objectives of MSP participants and (2) the actions they deem relevant for achieving the objectives are considered and used to study shared understanding.

Stakeholder engagement is considered necessary to identify and alleviate structural constraints and institutional challenges in R4D (Foran et al., 2014). There exist a variety of definitions in the R4D literature. These can refer to involvement in communication, i.e. discussions, meetings; others refer to involvement in decision making (Connell, 1995; Holman, 2008), implementing activities (Moreyra and Wegerich, 2006; van der Valk, 2007), contributing resources (King et al., 2010), or a combination of these (Adekunle and Fatunbi, 2012; Zornes et al., 2016; Home and Rump, 2015). In this paper, we capture all of the abovementioned definitions of engagement.

Learning is a process that is extensively categorized as a key performance driver in the R4D literature. Learning happens in MSPs in two major ways: social learning and individual learning. Social learning refers to the collective capabilities of stakeholders of MSPs, and individual learning refers to the capacities of individuals (Reed et al., 2010), i.e. MSP participants. Learning happens on different aspects related to interventions such as targeted livelihood impacts or outcomes, e.g. improved nutritional status (Devaux et al., 2009), better water management (Lebel et al., 2010), and innovations that contribute to these goals such as linking farmers to value chains (Thiele et al., 2011; Devaux et al., 2009). In this study, we investigate the collective capacities of stakeholders involved in R4D events related to targeted livelihood impacts or outcomes and innovations targeted by the intervention.

5.2.3 Methodological framework

Study context

The study was conducted under the CGIAR Research Program on Integrated Systems for the Humidtropics (Humidtropics). Humidtropics was implemented between 2013 and 2017. The program covered different regions, one of which was East and Central Africa. The East and Central Africa region includes Burundi, the eastern part of DR Congo, Rwanda, and Uganda. Humidtropics aimed to improve livelihood and innovation systems by reducing rural poverty, increasing food security, improving nutrition and health, and strengthening the sustainable management of natural resources. To reach its goals, Humidtropics focused on improving agricultural productivity, access to affordable food, and consumption of nutritious foods, on decreasing environmental harm from agriculture, and on improving the capacity of local innovation systems to innovate (CGIAR, 2012).

Study sites

The study investigated 10 MSPs operating in Burundi (2), DR Congo (2), Rwanda (3), and 176 Uganda (3) (Figure 5-2). In each country, one of the MSPs was based in an urban area and the others in rural or semi-urban areas, except eastern DR Congo, where there was no city.

5.2.4 Data collection and analysis

Data for this study were collected using LESARD, which combines different qualitative and quantitative data collection, analysis, and reporting tools (Sartas et al., 2017). In the study, two short surveys were used, e.g. Event Log and Learning Log. The LESARD Event Log registers the date, location, funding, information, and documentation tools used in R4D events and type of activity (Annex 5-1). The Event Log was administered for every event, including platform meetings, smaller meetings between individuals, training sessions, and field and fundraising activities. The second short survey is the LESARD Learning Log, which records the individual perspectives of the stakeholders attending R4D events. It includes open-ended questions on participants prioritized personal objectives, actions they think fit best for achieving their personal objectives, desired innovations, the participants' awareness and knowledge of interventions, and information needed to improve the MSP process (Annex 5-2). The Learning Log was administered in only some of the R4D events due to time and other administration limitations. This might lead some stakeholder types to have a larger influence on the dynamics if participation depends on the type of event. We consider this potentially large influence in our result section.

The data were analyzed using three methods. The first method was content or text analysis (Table 5-2). The responses given to the focus questions, i.e. (1) questions on personal objectives, (2) activities that fit best to achieve these objectives, (3) the participating stakeholders' knowledge about the intervention, were analyzed to identify stakeholders' shared understanding, engagement, and learning. We used QSR Nvivo v.10 to conduct the text analysis based on the indicators discussed in section 2.3.3.

The second method was trend analysis (Table 5-2). Initially, the values of the indicators (see section 2.3.3) of the four key performance drivers were calculated for each R4D event by taking averages of the individual values of each participating stakeholder. Afterwards, monthly averages of the values were calculated for each MSP using the number of days since the first event of the relevant MSP. Trend lines were developed by averaging the monthly averages for all the MSPs. Monthly averages were used to minimize the bias that an exceptional event might introduce into the values of the indicators of the key performance drivers. Trend analysis was conducted using IBM SPSS v.23 to fit the trend lines. The third method was correlation analysis. We used

Figure 5-2. Map of geographical sites in which the intervention operated.

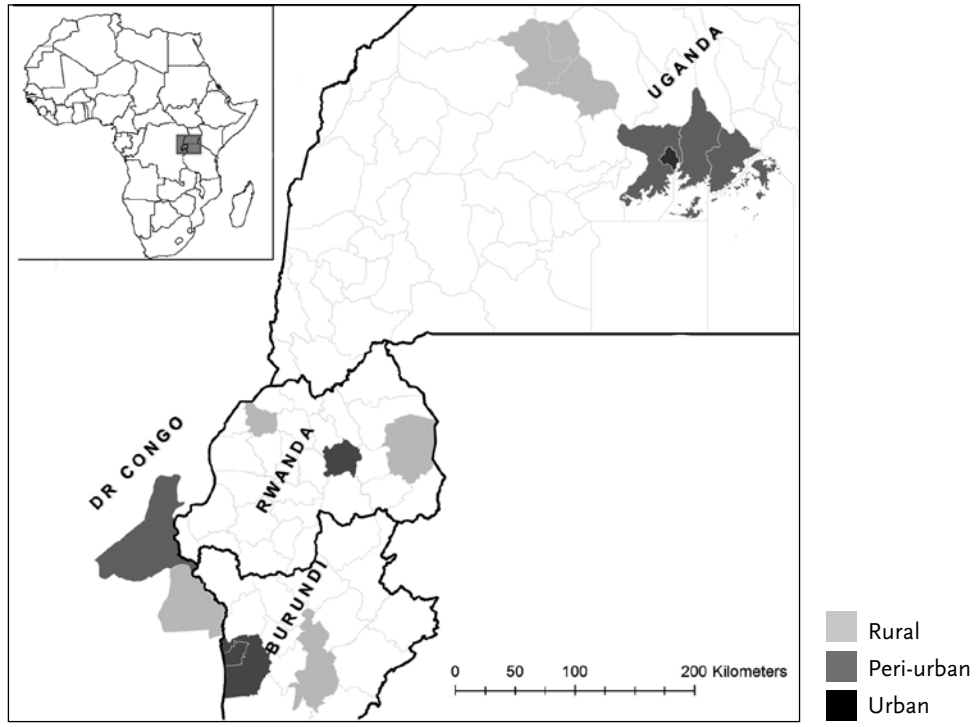


Table 5-2. Overview of data collection and analysis of key performance drivers.

Key performance driver	Data collection time	Number of respondents	Analysis approach
Participation	Each MSP event	3-84 people	Trend analysis
Shared understanding	All meeting-type events	3-28 people	Text analysis, trend analysis
Engagement	All meeting-type events	3-28 people	Text analysis, trend analysis
Learning	All meeting-type events	3-28 people	Text analysis, trend analysis

Table 5-3. Variables used to investigate key performance drivers.

Key performance driver	Variable	Variable descriptions
Participation	An integer	Number of people attending R4D event
Shared understanding	A ratio	Number of distinct subjects mentioned in the responses to focus questions on distinct objectives and actions to achieve the objectives in an event, divided by the total number of participants in the event
Engagement	A scale	Average of individual engagement level of stakeholders participating in the event, taking values between 1 and 7
Learning	A ratio	Average of individual knowledge level of stakeholders participating in the event about the subjects of key learning goals of the intervention, taking integer values between 1 (no knowledge) and 5 (full knowledge)

simple and partial correlations between the key drivers and potential contextual factors that may trigger change in the key performance drivers, such as time, country, the location of the R4D event along the rural–urban gradient, the share of funding provided by the organization managing the MSP, and type of R4D event. We used SPSS v.23 to generate simple and partial correlations.

Indicators

We used the LESARD indicators to measure the performance drivers. They were generated by quantifying text responses with the details provided in the following sections (Sartas et al. 2017).

Each key performance driver was investigated using the number of participants in the R4D event and the value of the indicator calculated by text analysis (Table 5-3). Details about the process to calculate the indicators are provided in the following subsections.

Participation

We measured participation by the number of individual stakeholders in the R4D events. In each event, an attendance list was compiled, and the number of participants was recorded. We scaled participation by dividing the number by 10 for representation purposes.

Shared understanding

Words in the survey responses relating to (i) R4D activities, (ii) crops, (iii) research and action themes were matched using all the responses given in an R4D event. Words with identical meanings in the intervention context were divided into several groups, and the number of groups was considered as the total number of distinct words in the event. R4D activity words included a broad range of action verbs, such as planting, doing research, and so on. Crops and themes were specific words. Crop words included crop name, i.e. banana, potato. Theme words included the categorization used by the intervention: productivity, income, sustainability, nutrition, empowerment, and innovation capacity. The average number of distinct words per individual stakeholder attending the R4D event was used to represent the overall shared understanding of the R4D event. As shared understanding is inversely related to the average number of subjects per person, we used the multiplicative inverse of the average number of subjects to study shared understanding, thereby enabling an easier interpretation of the results.

Engagement

To measure engagement level, action verbs from the responses to stakeholder objectives were used. Text answers provided by the survey participants were matched with a list of words relating to different engagement levels (Annex 5-3). These words were identified by the authors and a research assistant who participated throughout the MSP process. The researchers associated the words with seven different engagement levels. The results were compared by using Kappa-statistics (Viera and Garrett, 2005). After two rounds of discussions and reassignment of the words in the categories, a Kappa statistic of .74 was achieved, indicating a high level of agreement. To identify the engagement levels, the researchers modified Rosenblatt's (Rosenblatt, 2013) engagement pyramid, where individual stakeholders (1) become aware, (2) become interested, (3) get to care about, (4) start to believe in the validity and suitability of an intervention to achieve innovation and livelihood goals, (5) start spending time on R4D activities and events on a regular basis, (6) take more responsibility, and finally (7) lead the R4D events.

Learning

The R4D program within which we collected our data (Humidtropics) had two major learning objectives. It aimed to improve the awareness and understanding of (1) integrated systems approaches and (2) innovations identified, experienced, diffused, and used in the program. Integrated systems approach refers to the consideration given to the positive and negative interactions between different objectives, actors, and scales of livelihoods, including productivity, income, sustainability, nutrition, empowerment, and innovation capacity (CGIAR, 2012). Innovations refer to novel tech-

nological and institutional products, methods, and approaches that can positively impact livelihoods.

To measure learning, responses given to the question on necessary innovations to improve livelihoods were used. For integrated systems approach, we checked whether they contained any references to embedded systems, synergies, and trade-offs of livelihood aspects of R4D activities (Annex 5-4). To measure learning about innovations, the responses were analyzed for the specific innovations to which respondents referred (Annex 5-4). To determine awareness and understanding of R4D events, the scores for integrated systems approach and innovations were summed and divided by two. The average of the scores of stakeholders participating in the events was taken to represent awareness and understanding of the particular R4D event.

Contextual and intervention-related factors influencing key performance drivers

In this paper, we study the relations between key performance drivers and five common contextual and intervention-related factors that have been argued to affect these drivers, i.e. time (Faysse, 2006; Zornes et al., 2016; Head, 2008; Hekkert et al., 2007), country of intervention (Hermans, 2017), location of the R4D event on rural–urban gradient (Comby et al., 2014; Raford, 2015), share of funding provided for the R4D events by the organization managing the MSPs (Faysse, 2006; Johnson et al., 2003), and type of R4D event (Kongo et al., 2010; Lamb et al., 2016). We use the variables specified in Table 5-4.

Table 5-4. Variables used to measure the relations between contextual and intervention-related factors and key performance drivers.

Factors	Variable	Values
Time	Integer	Number of days since the inception date in the country of operation
Country	Integer	1: Burundi, 2: DR Congo, 3: Rwanda, 4: Uganda
Location of the R4D events	Integer	1: Rural, 2: Peri-urban, 3: Urban
Share of funding by the managing organization	Ratio	The ratio of the following cost items covered by the managing organization: lunch or dinner, coffee or tea, transportation of the participants, daily allowances provided to participants, venue of the event, facilitator or invited speakers, accommodation, invitation, or mobilization

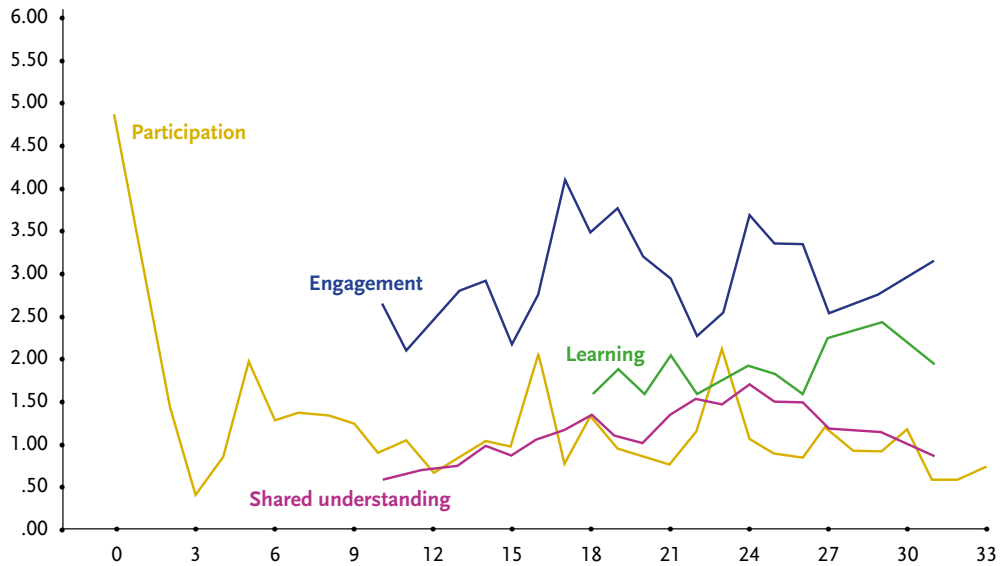
5.3 Results

5.3.1 Key performance drivers during the intervention

Data on participation, shared understanding, engagement, and learning in the events during the first three year of the intervention show that each key function has different dynamics (Figure 5-3). Following an early kick-off month where on average more than 50 people participated, participation was stable around eight to nine people per event, except for three dramatic increases that occurred in Months 5, 16, and 23. In these three months, average participation increased to 20 people/event. Shared understanding represented two major trends that had a vertex in Month 24. Between Months10 and 24, there was a steady increase in shared understanding from 0.5 (2 subjects/person on average) to approximately 1.75 (0.6 subjects/person). From Month 24 onwards, shared understanding decreased and reached 1 in Month 30.

Engagement was the most volatile of the key performance drivers in our cases. During the 20 months for which engagement data are available, engagement levels shifted between 2 (i.e. cares) and 4.5 (i.e. believes, spends time) with three cycles lasting four, seven, and six months. Engagement peaks followed one month after participation peaks. Learning level presented an upward trend, but with large fluctuations observed at short time intervals (i.e. 1-3-month intervals) (Figure 5-3).

Figure 5-3. Dynamics of participation, shared understanding, engagement, and learning in R4D events organized through multi-stakeholder platforms.



5.3.2 Relationship between key performance drivers and time, country, location, funding, and event type

The correlations between key performance drivers and factors potentially affecting them, i.e. time (month), country of the intervention, location of the R4D events along rural–urban gradient, share of MSP organization funding for the R4D event, and type of R4D event, were mostly insignificant, at the 5% confidence level (Table 5-5). Participation was significantly correlated only with location of the R4D event along the rural–urban gradient. Shared understanding and learning were significantly correlated with time, and engagement had no significant correlation with the factors investigated.

Table 5-5. Correlations between key performance drivers and potential contextual and intervention-related factors that influence them. Only significant correlations are indicated.

Factors	Key performance drivers			
	Participation	Shared understanding	Engagement	Learning
Time		.369		.288
Rural-urban location	-.331			

5.3.3 Relationships among key performance drivers

Data analysis showed that participation in the R4D events was significantly correlated with shared understanding and engagement, even when other contextual factors that can affect the drivers were controlled for. Participation was positively correlated with shared understanding with a coefficient of .362 and with a month lagged engagement level of .680.

5.4 Analysis and discussion

During the three years of the intervention, all four key performance drivers that influence the contribution of the MSP to achieving the objectives of the R4D program were volatile. Participation, level of shared understanding, engagement, and knowledge on the subjects targeted by the learning objectives of the intervention in the R4D events all fluctuated during the MSP implementation (Figure 5-3). This confirms the argued dynamic nature of multi-stakeholder processes in R4D contexts (Dickson-Gomez et al., 2016; Kilelu et al., 2013; Sanginga et al., 2007; Alsop and Farrington, 1998; Neef and Neubert, 2011; Eriksson et al., 2014). It also indicates that the dynamism has multiple dimensions.

The relations observed between the key performance drivers and contextual factors revealed different patterns (Figure 5-3). Time was significant only for shared understanding and learning (Table 5-5). For both of these key performance drivers the correlation coefficients were positive. In other words, shared understanding and learning can present a positive trend for more than a year, when MSPs are used (Figure 5-3). In the 10 MSP cases across the four countries investigated, stakeholders developed a shared understanding about the objectives and the activities to achieve their joint ambitions. This is similar to other MSP cases published earlier (Kefasi et al., 2011; Richardson and Grose, 2013; Gupta, 2014). The stakeholders also improved their awareness and knowledge about the systems approach, as well as about the innovations identified, experienced, diffused, and used by the program. This also supports findings from earlier studies (Kilelu et al., 2013; Neef and Neubert, 2011; Blignault et al., 2015; Hall et al., 2000). However, the average number of participants in the R4D events and the average engagement levels presented cyclical aspects. During the three years investigated, both participation and engagement experienced three major cycles of increase and decrease in average terms (Figure 5-3). In other words, we observed no trends or increases in participation and engagement that lasted more than three months. This does not conform with the results observed in previous cases, which argued that participation (Rothenberger et al., 2005; Huibers et al., 2010) and engagement (Abbott, 2012; Rothenberger et al., 2005) increased during the MSP process. In other words, in terms of participation and engagement, MSPs do not ensure an increase in participation and engagement throughout the R4D implementation. Volatility in the key performance drivers and the different patterns of dynamics imply that the contribution of MSPs to intervention performance is very susceptible to the timing of R4D events. Moreover, factors that can be controlled by the intervention, i.e. event funding and type of events organized, were not significantly correlated with the key performance drivers. In other words, the influence of the organization managing the intervention on the level of key performance drivers might not be very big in the early years of the intervention. Therefore, to benefit from MSPs, interventions might need to adopt a tactical approach, i.e. to identify windows of opportunity in terms of time periods and schedule their events using the identified opportunity periods. For instance, in the cases studied, a typical dissemination activity that requires the participation of more than 15 stakeholders/event on average for a month can be pursued only in Months 5, 16, and 23 (Figure 5-3). If an activity requires a time investment from the majority of the stakeholders, such as introducing a new accountability system for releasing intervention funds, in our cases they can be effectively completed only in Months 17 and 24, when the average engagement level reached level 5 (Figure 5-3). Although the timing of these high opportunity periods can change for each intervention, their identification and utilization have the potential to improve the performance of interventions.

In the cases studied, participation was significantly correlated with shared understanding and engagement with a time lag of a month, even when we controlled for the factors investigated (country in which the intervention operates, location of the event along rural–urban gradient, share of funding provided to the R4D event, and type of event organized by the organization leading the intervention). We observed that the participation of a larger number of people does not necessarily decrease shared understanding, which would be the case unless new participants had the same ideas and opinions. The fact that shared understanding did not fall suggests that R4D events might attract stakeholders with similar objectives and similar innovation priorities throughout the intervention period when they are organized by MSPs.

In addition, our results indicate that engagement increased substantially (Figure 5-3) when the number of participants increased, albeit with a month's delay. Although the factors that explain a high degree of correlation between participation and engagement (.68) might be other factors that we did not control for in our study, it is also possible that an increase in participation might lead to an increase in engagement. One reason for the increase might be that more participation motivated the existing participants to take responsibility in the intervention. This might be especially true when the objectives and the activities of the intervention require a broad level of skills and competences (Kasonde and Campbell, 2012; Stringer et al., 2014; Klenk and Wyatt, 2015). A second reason might be that the newcomers are more engaged at the beginning of their participation in the MSPs and lose their engagement as the process progresses. Some previous studies have argued that the engagement of some stakeholders might decrease because of conflicting personalities, institutional differences (Sanginga et al., 2007), power imbalances (Buckland-Merrett et al., 2017), and losing incentives. Another reason for the decline in engagement argued in the literature is 'participation fatigue' (Du Toit and Pollard, 2008) whereby stakeholders become disengaged from the intervention as their priorities and interests are not sufficiently pursued by the MSPs (Boogaard et al., 2013) and/or the likelihood of acquiring new information, networks, and business opportunities decreases over time.

The potential interdependence of participation, shared understanding, and engagement could also lead to windows-of-opportunity periods of high participation, shared understanding, and engagement. In our cases, Months 17 to 18 and 24 to 25 were such points that might offer a rare opportunity for the intervention to pursue its activities. This would enable interventions organized through MSPs to improve their performance by monitoring the performance drivers and identifying these opportunity periods to pursue their objectives.

5.5 Conclusions

Our study aimed to investigate three major research questions. We explored (1) whether participation, shared understanding, engagement, and learning in R4D events are dynamic as suggested by the literature, (2) whether the dynamics and patterns can be explained by contextual or intervention-related factors, including country, location of operation, funding mechanisms, and type of R4D events, and (3) whether there are periods when participation, shared understanding, engagement, and learning present a similar pattern.

Our study confirmed that key performance drivers that moderated the contribution of the MSPs to interventions (i.e. participation, shared understanding, engagement, and learning) are highly dynamic as suggested by the literature, but with distinct trends and cyclical patterns over time. Whereas participation and engagement had no trends, shared understanding and learning had upward trends. Whereas sudden increases in participation were short-term and participation fell back quickly to its pre-increase level, sudden increases in engagement waned gradually. Our study also indicated that some of the contextual and intervention-related factors can partially explain the dynamics observed in key performance drivers. However, the contextual and intervention-related factors that affect the dynamics of each key performance driver are different. Among the factors investigated, time was significantly linked to shared understanding and learning, and location of the R4D event along the rural–urban gradient was linked to participation. Country and type of R4D events and funding allocated to them were not significantly linked to any of the four key performance drivers. Our study also showed that, during the R4D events, there can be windows of opportunity when participation, shared understanding, and engagement are high in some periods. However, learning was not related to any of the other drivers investigated; this implies that its dynamics can be independent of the other drivers.

In this study, we found that intervention factors, i.e. funding, event type, have less influence than geographical, rural–urban gradient, and temporal factors, time, on key performance drivers. In other words, the factors that can be controlled by the intervention management might have less influence than existing geographical and temporal conditions, especially for participation and engagement. This implies that intervention performance might be higher if the MSP management strategies are based on identifying and better using windows of opportunity in reaction to autonomous key performance dynamics, rather than trying to determine the dynamics with intense efforts and investments. Furthermore, investigating whether the nature of the dynamics of key performance drivers is more autonomous or more induced by the intervention could enhance the results of our study. Moreover, in our study, we found some peri-

ods when high participation, shared understanding, and engagement overlap. Developing further understanding of these periods and potential factors that explain these periods might make an important contribution to the literature on the contribution of MSPs to the performance of interventions.

5.6 Acknowledgements

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5.7 Annexes

Annex 5-1: Event Log

LESARD Event Log aims to collect information about any event organized as part of a multi-stakeholder platform process. It needs to be administered in ANY SIGNIFICANT EVENTS that will have an impact on the evolution of, and decision making in, that multi-stakeholder process. It is advised to start with the form before the event and finalize it after the event is completed.

1. Please choose the country in which the event took place
2. Filled in by:
3. Please specify the name of the event, if there is any
4. Please specify the start date and time
5. Please specify the end date and time
6. Please specify the event venue, section in the city, and city
7. Please select the type of the event. Please select all that apply

Available options are
- Preparation meeting for the upcoming event platform meeting
- Platform sub-group/team meeting reflection meeting
- Implementation meeting
- Capacity creation or building / training
- Field trial setup
- Monitoring the field, data collection research meeting for
- Researchers' promotion event on the platform and its activities
- Fundraising event for the platform-specific events organized by platform member organization(s)
- Other:

Which information tools are utilized for the event? Please select all that apply.
- No information about the event was provided to participants
- E-mails about the event's specifics were sent before the event
- Participants were called and were given an update before the event
- Participants were sent a calendar invitation and short description
- Before the event, participants were sent brochures, letters, and other hardcopy materials before the event; handouts are distributed during the event
- Presentations made using PowerPoint, Prezi etc. during the event.
- Organizers give oral updates during the event about specific information tools and exercises done during the event
- Results from the experiments and process learning discussed during the event
- Other:

Which documentation is done for the event?
- None
- Meeting minutes
- Boards, blackboards
- Pictures
- Event log
- Learning log
- Other questionnaires
- Audio record
- Video record
- Posters, papers, card created in the event
- E-mails, other online means
- Reports about the event
- Other:

Resource contribution except labor time

	Farmers	CGIAR Center	Local Government	Local NGO	National Government
Lunch or dinner					
Coffee, tea, and snacks					
Daily allowance					
Cost of the venue					
Facilitation cost					
Other costs					

Please specify all remarks about the event that Humidtropics and the team need to notice.

Annex 5-2: Learning Log

LESARD Learning log aims to study the priorities and needs of the participants. Therefore, reporting participants' personal perspectives is key to the success of the process. The results are used to increase the contribution of the meetings and events in the future to the project and development of the region and are not used outside of the project and research context.

1. Please choose the options that describes you. Please select as many as possible.
   Female o
   Male o
   Youth o
   Adult o
   Single o
   Married o
2. What are your personal objectives for attending this specific meeting? Please specify your own objectives. They can be same as, or different from the specified agenda.

3. How can these objectives be achieved? Please specify all important improvements, changes that needs to happen.
4. Which innovations are being experimented with in the Humidtropics program in your area? Please specify all Humidtropics innovations/experiments.
5. With which organizations have you communicated in your work in the last 2 weeks? Please specify all the organizations.

Annex 5-3. Engagement levels and the expressions associated with the levels.

Level	Category	Main propositions	Action words used by the stakeholders during the R4D event
1	Aware	Find out, listen, network, persuade, promote my..., represent, see, share, show, suggest	Connect, contact, emphasize, establish partnership, explain, find out, give information, give update, hear, identify partners, illustrate, interact with, introduce my..., listen, meet, monitor, network, observe, pass information, persuade, present, promote my..., provide information, persuade, represent, see, share experience, share ideas, share information, share report, share update, show, suggest, view
2	Level 1 and interested	Assess, attend, document, find solutions for my..., get, know, learn, understand	Acquire information, analyze, assess, attend, capture information, check, clarify, document, enhance my capacity, evaluate, explore, find solutions, gain insight, get experience, get familiar, get feedback, get ideas, get information, get insight, get report, get results, get solutions, get trained, get update, interpret, know, learn, map activities, measure, receive comment, report, review, synthesize, track, understand
3	Level 2 and cars	Discuss, follow up, give feedback, reflect	Brainstorm, deliberate, discuss, exchange ideas, exchange experiences, talk about, follow up, give feedback, reflect
4	Level 3 and believe	Access, agree, align with, consult, cooperate, decide, appreciate	Access to innovations, access to market, agree, align with, appreciate, boost platform, buy, collaborate, consult, cooperate, decide, determine, get inputs, get tools, improve together, increase together, resolve, sell
5	Level 4 and spend time	Contribute, involve	Assist, contribute, engage, help, involve, participate, support
6	Level 5 and responsible	Complete, deliver, develop, establish, facilitate, implement, plan, promote intervention, research, serve, strengthen, solve, train, work	Complete, deliver, design, develop, establish, facilitate, finalize, finetune document, identify entry points, identify roles, identify activities, identify teams, implement, improve other livelihoods, increase others livelihood options, map jointly, plan, prepare, progress, promote intervention, research, serve, set up, solve, strategize, strengthen other stakeholders, teach, train, work on focus innovation
7	Level 6 and lead	Lead, organize	Lead, organize

Annex 5-4. Learning focus and propositions, words, and values used to measure learning.

Learning focus	Category	Main propositions	Action words used by the stakeholders during the R4D event
Integrated systems approach	Group A (direct link to learning focus): Embedded systems Synergies Trade-offs	Innovation systems, livelihood systems, synergies, systems analysis, systems integration, trade-off	1. No reference 2. Group B 3. Group B with examples 4. Group A 5. Group A with examples
	Group B (indirect link to learning focus): Integrate innovation-A and innovation-B Multi-stakeholder engagement	Croplivestock integration, linking different stakeholders, market linkage, multi-stakeholder partnerships, multi-stakeholder platform, value chain, innovation platform, intercropping, R4D platform	
Innovations	Specific innovations about: Capital access, Communication approaches and tools Environmental protection approaches and tools Farmer mobilization methods Gender empowerment approaches and tools Health practices, Innovation diffusion tools Market access Production inputs Production methods	Collective marketing, cooking techniques, credits, crop protection techniques, environmental protection methods, internet vegetable marketing, farmer credit, farmer platforms, gender analysis tools, gender awareness methods, good agricultural practices, grant models, fertilizers, ICT, innovation platforms, intercropping, introducing new commodities, knowledge exchange approaches, new seeds, organic agriculture, schools as innovation broker, soil fertility management, video-based sensitization, youth engagement approaches, zoonotic disease control	Number of distinct livelihood aspects among productivity, income, sustainability, nutrition, empowerment, and innovation capacity

Annex 5-5. Detailed event types organized in interventions.

Event type	Stakeholder type	Agenda
Implementation meeting	Intervention team	Project management and administration
Preparation for the next event	Intervention team, local facilitators, field staff	Event organization, logistics, invitations
MSP meeting	All stakeholders	All items
Sub-group event	A delegated small team	Special agenda issued in the MSP meeting
Reflection meeting	Intervention team	Performance of R4D event, updating intervention approach
Capacity building	All stakeholders	Training provision
Researcher meeting	Researchers	Research issues
Promotion event	All stakeholders	Promoting intervention, its innovations
Fundraising event	Intervention team, donors	Fund raising
Member event	An MSP member host, R4D intervention team	Agenda defined by the hosting member
Field setup	Researchers, targeted users of R4D innovations	Establishing a field experiment, the first survey

6

Factors Influencing Participation Dynamics in Research for Development Interventions with Multi-Stakeholder Platforms

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Abstract

Multi-stakeholder platforms (MSP) have become mainstream in projects, programs, and policy interventions aiming to improve innovation and livelihoods systems in low- and middle-income contexts, i.e. research for development interventions (R4Ds). However, the evidence for MSPs' contribution to the performance of R4Ds and their added value is not compelling. This paper focuses on a process driver that is related to MSPs' contribution to the performance of R4Ds, i.e. stakeholder participation. It combines the results of a review on participation in R4D interventions across three major disciplines, i.e. health, environment, and agriculture, using a metric approach. It utilizes time-series models to investigate the factors that influence stakeholder participation with data obtained from 411 different events organized in a period of approximately three years. It shows that, in three Ugandan MSP cases studied, stakeholder participation increased both in nominal and in unique terms. Moreover, participation was rather cyclical and fluctuated during the R4D intervention. The results also show that, in addition to locational and intervention factors such as type of intervention area along a rural–urban gradient and human resources provided for MSP implementation, temporal elements such as periods when different specific R4D objectives are pursued and the phase of the innovation development process play significant roles in influencing participation.

6.1 Introduction

Multi-stakeholder platforms (MSPs) have been attracting increasing attention from different agencies aiming to improve innovation and livelihood systems (hereafter systems). MSPs have been utilized to facilitate different research for development interventions (R4Ds) relating to the design and implementation of government or business policies (Beers and Geerling-Eiff, 2014) and international research and development programmes and projects (Schut et al., 2014). The literature on MSPs covers a broad range of themes, including sustainable agricultural intensification (Schut et al., 2016c), natural resource management (Warner, 2006a; Faysse, 2006), environment management (Kaiser et al., 2016), and health (McHugh et al., 2016). Specific forms of MSPs include innovation platforms (Schut et al., 2016b), public–private partnerships (Reypens et al., 2016; Spielman et al., 2010), sustainability platforms (Munoz-Erickson and Cutts, 2016), and learning alliances (Verhagen et al., 2008).

R4Ds aim to improve complex systems and require approaches and tools that enable holistic identification and analyses of both constraints and opportunities (Bawden, 1992; Hall and Clark, 2010). This implies that R4Ds need to respond to the needs and challenges faced by different stakeholder groups (Foran et al., 2014; Klerkx et al., 2012; Martin et al., 2013), making collective action and multi-disciplinary, multi-stakeholder partnerships between research and development actors key for their performance (McHugh et al., 2016; Bawden, 1992; Hall and Clark, 2010). MSPs have gained momentum in the R4D world, notably because of their ability to foster collective action across multi-disciplinary actors (Kaiser et al., 2016; McHugh et al., 2016; Hemmati, 2002). Their popularity is especially high in low- and middle-income countries where partial or non-participatory approaches have frequently been reported as insufficient to improve systems (Norman, 2002).

Although MSPs are popular, available evidence on their specific contribution to the performance and impact of R4Ds (hereafter MSP contribution) has been scarce. MSPs have been reported to contribute to achieving objectives of R4D objectives (McHugh et al., 2016; Sartas et al., 2017; Thiele et al., 2011), but also to delivery failures (Beers, 2014; Faysse, 2006; Biermann, 2007; Turnhout, 2010). Consequently, several studies have tried to identify the factors that influence MSP contribution. Many of these studies converge around the role of several processes that influence MSP contribution, i.e. process drivers.

Among these process drivers, stakeholder participation (hereafter participation) has often been identified as a key indicator (Faysse, 2006; Amerasinghe et al., 2013; Lamers et al., 2017; Larmarange et al., 2015). Stakeholders' interest and participation in

R4D events are considered to be related to the success of R4Ds (Wong et al., 2014; Roloff, 2008; Sena et al., 2017). In addition, MSPs are assumed to align participation to current activities of R4Ds (Amerasinghe et al., 2013; Lamers et al., 2017). In other words, in their ability to enhance higher and better participation in R4Ds (Johnson et al., 2003;), MSPs are considered to increase the impact of R4Ds. Therefore, a better understanding of participation in R4Ds when they are organized through MSPs has the potential to contribute to increasing the impact of R4Ds and scaling R4D innovations in low- and middle-income intervention contexts.

A recent study, currently under review, investigated the dynamics of participation together with other process drivers that influence MSP contribution, such as shared understanding, engagement, and learning. It showed that participation in R4Ds is highly dynamic when it is organized through MSPs. This current study elaborates the discussions and conclusions of the recent study and contributes to the literature by providing scarce quantitative evidence about MSP contribution. It further zooms in on understanding participation dynamics and various factors contributing to these dynamics. By using one of the first metric approaches to studying participation and by modelling the factors contributing to the dynamics, it provides the first comparative evidence on the role of each factor for R4D interventions using MSPs.

The objective of this chapter is to investigate how participation in R4Ds is affected by location-related, intervention-related, and temporal dynamics, and how this is related to MSP contribution. It focuses on three MSP cases from Uganda that were implemented under the CGIAR Research Program on Integrated Systems for the Humid Tropics (Humidtropics) between August 2013 and May 2016. The chapter addresses two research questions: (1) Is stakeholder participation dynamic in R4Ds? (2) How is participation in R4Ds influenced by contextual (locational, intervention-related, and temporal) factors when R4D participation is organized by MSPs? Based on the answers to these questions, the chapter articulates the implications of utilizing an MSP approach to organize participation in R4Ds that can inform research, policy, and development actors on how best to allocate their resources to achieve their objectives.

6.2 Conceptual and methodological framework

6.2.1 R4D interventions and MSPs

The R4D literature has various definitions for R4Ds and MSPs. From a view that we conducted for this study, we define R4Ds with three major characteristics. First, systematic research plays a vital role, and an important proportion of R4D resources are spent on systematic research (Delisle et al., 2005; Laws et al., 2013). Second, R4Ds utilize a systems approach in which multiple objectives and innovations are pursued and the interactions among and between objectives and innovations are explicitly articulated (Delisle et al., 2005; Abate et al., 2011; Ashby, 2003). Third, R4Ds include participatory approaches (Abate et al., 2011; Davis and Whittington, 1998; Schut et al., 2016c) and multi-disciplinary teams (Laws et al., 2013; Ashby, 2003; Nuyens, 2007; Rosenfield, 1992).

Multi-stakeholder platforms (MSP) are defined as decision-making bodies (Steins and Edwards, 1999) or roundtables where a diversity of stakeholders (Warner, 2006a) get together to get things done (Röling and Woodhill, 2001a). Although this description is comprehensive and different approaches such as public–private partnerships (Reypens et al., 2016; Spielman et al., 2010; Abbott, 2012; Eggersdorfer and Bird, 2016; Hall, 2006; Yildirim et al., 2016; Tenywa et al., 2012), innovation platforms (Dror et al., 2015; Hermans et al., 2017; Sanyang et al., 2015), and sustainability platforms (Munoz-Erickson and Cutts, 2016; Kachel and Jennings, 2010; Zuurbier, 2010) are considered to be MSPs, an MSP is a specific form of institutional space for stakeholder involvement and engagement. We characterize MSPs as having several traits. First, they are not a single event but a series of events. Second, both research and non-research stakeholders are involved in, and influence decisions on, different intervention activities such as analysis of problems and design and implementation of research plans.

Therefore, R4D interventions organized though MSPs present a specific approach to implementation of systems interventions and MSPs are specific forms of stakeholder involvement. Although every R4D intervention carries participatory elements, not all R4Ds have an MSPs. In the R4D literature, there are various examples of interventions which are R4Ds with MSPs, either R4D or MSP, or none of these (Table 6-1). In this study, we focus on the intervention group that is an R4D intervention with MSPs

6.2.2 Definition of participation as a driver of R4D intervention performance

The relation between participation and using an MSP approach in R4Ds has been the subject of many studies (Adekunle and Fatunbi, 2012; Amerasinghe et al., 2013; Faysse, 2006; Warner, 2006). However, the understanding of what participation means varies significantly (Badibanga et al., 2013). For instance, participation has been defined as (1) simple attendance at R4Ds events (Leeuwis, 2000), (2) continuous involvement in these events (Sumberg, 2005), or (3) active influence on R4Ds' agendas (Leeuwis, 2000; Reed et al., 2010). Different types of participation include passive participation, participation by consultation, functional participation, empowering participation and interactive participation (Johnson et al., 2003; Leeuwis, 2000).

Table 6-1. Examples of interventions which carry different R4D and MSP characteristics in different R4D fields.

	Domain	With MSP	Without MSP
R4D interventions	Agriculture	Adekunle and Fatunbi, 2012; Schut et al., 2016	Beers and Geerling-Eiff 2014, Guiliani, 2013
	Environments	Bäckstrand, 2006; Derak et al., 2006	Reed, 2010 Hermans et al., 2011
	Natural resource management	Hämäläinen et al., 2001; Warner, 2006	Prell et al., 2009; Walker et al., 2010
	Health	McHugh et al., 2016 Kasonde and Campbell, 2012	Delisle et al., 2005 Whitword, 2008
	Other	Barlow et al., 2006 Bebbington and Farrington, 1993	Reypen et al., 2016 Roloff, 2008
Non-R4D	Agriculture	De Zeeuw, 2010 Fleury et al., 2008	Thompson et al., 2000 Pretty et al., 2006
	Environments	Abbott, 2012; Bosher et al., 2009	Meyer et al., 2011 Saysel et al., 2002
	Natural resource management	Warner, 2007 ; Fliervoet et al. 2017	Steinmann et al., 2006 Agarwal, 2011
	Health	Magesa et al., 2005 Eggersdorfer and Bird, 2016	Yasuoka and Levins, 2007 Berti et al., 2004
	Other	Huang et al., 2017 Mayangsari and Novani, 2015	Beall and Todes, 2004 Balan et al., 2013

In this chapter, we use a simple definition of participation as referring to stakeholders' physical attendance at diverse R4D events. We further unpack participation and investigate it both in nominal terms – number of stakeholders – and in unique terms – number of distinct stakeholders. In addition, we investigate both non-cumulative and cumulative participation.

6.2.3 How does participation change?

Many studies have argued that participation changes when it is organized through MSPs (Adekunle and Fatunbi, 2012; Amerasinghe et al., 2013; Edquist, 2011; Roloff, 2008a), and the change is mostly in the form of an increase (Kongo et al., 2010; Richardson and Grose, 2013; Roloff, 2008a). In addition, numerous studies have argued that, in R4Ds, MSPs go through several phases, of which details are discussed in section 2.3.3 (Beers and Geerling-Eiff, 2014; Comby et al., 2014; Edquist, 2011; European Commision, 2014; Johnson et al., 2003; Nikitina et al., 2010; Roloff, 2008b; Sauser et al., 2006). These studies argue that participation increases as R4Ds advance through these phases.

6.2.4 Factors affecting participation

In the R4D literature, participation has been argued to depend on diverse (1) locational (Aw-Hassan, 2008; Hale and Mauzerall, 2004; Joy et al., 2008), (2) intervention-related (Johnson et al., 2003; Joy et al., 2008; Schut et al., 2016b), and (3) temporal (Faysse, 2006; Head, 2008; Hekkert et al., 2007; Zornes et al., 2016) factors. In this paper, we study these three types of factors.

Among various specific factors in these three categories, we study seven specific factors in total, which are frequently discussed in the literature and can be empirically investigated within the limitations of the resources provided for the study. One of the specific factors is locational-related (geographical location in which the R4D operates), three are intervention-related (funding, human resources provided by the R4Ds, and type of event), and three are temporal factors (periods based on different R4D objectives, innovation development process, and other time aspects).

Location-related factors

The R4D literature includes many studies focusing on the locational aspects that influence stakeholder participation in R4Ds (Comby et al., 2014; Hale and Mauzerall, 2004; Raford, 2015). Comby et al. (2014) argued that local communities' interests were different from those of national and regional actors, and that consequently their participation in R4Ds is higher as these have a more direct impact on their livelihoods. Moreover, local media more frequently refer to specific local problems, attracting more widespread attention and interest in such issues. Raford (Raford, 2015) added that local actors' deeper local expertise can increase the relevance of the R4Ds for local actors, and thus their participation. These arguments propose that stakeholder participation in R4Ds is higher at local level. In this chapter, we investigate whether this proposition is valid in our cases to better understand the nature of participation and articulate the implications of using an MSP approach in R4Ds.

Intervention-related factors

As with the locational factors, the literature includes multiple studies focusing on the intervention factors influencing participation. Examples include detailed level of planning, i.e. clarity of impact pathways and theory of change (Aw-Hassan, 2008), flexibility in implementation (Joy et al., 2008), and the type of organization managing the R4Ds project and/or MSP (Schut et al., 2016b). Among the intervention-related factors, three major aspects are more commonly instanced: (1) funding (Aw-Hassan, 2008; Faysse, 2006; Johnson et al., 2003), (2) human resources (Aw-Hassan, 2008; Greenhalgh et al., 2004; Hall et al., 2003; Zornes et al., 2016), and (3) type of event (Kongo et al., 2010; Lamb et al., 2016).

It has been argued that the amount of funding provided to MSPs increases participation (Aw-Hassan, 2008; Faysse, 2006; Johnson et al., 2003) by providing monetary incentives for participation (Foran et al., 2014; Gupta, 2014) and improving the quality of MSP processes (Sartas et al., 2017). In addition, human resources allocated have been argued to influence participation. The existence and quality aspects of champions who promote and improve the legitimacy of the R4Ds (Boogaard et al., 2013; CGIAR, 2012; Fazey et al., 2014; Kilelu et al., 2013), facilitators who manage communication and negotiation in the MSPs (Klerkx et al., 2012; Pali and Swaans, 2013), organizers who arrange logistics and infrastructure (Sartas et al., 2017), and documentation people who monitor and communicate R4D events, decisions, and successes (Klerkx et al., 2012; Sartas et al., 2017) have been especially argued to play important roles. Moreover, the type of R4D event is argued to influence participation. For instance, an implementation event that focuses on administrative and project management issues (e.g. financial planning meeting) typically includes few stakeholders, most of whom are employed by the organization managing the R4Ds, whereas a promotional event (product demonstration event) that aims to disseminate knowledge and innovations often includes many stakeholders.

Temporal factors

The R4D literature discusses two major temporal factors that influence participation in R4Ds when MSPs are used. It argues that participation increases or decreases in specific time periods. For instance, participation is argued to decrease in holiday periods (Aaltonen and Kujala, 2010; Barrientos et al., 2003) and increase in planting periods in R4Ds focusing on agriculture (Assaye et al., 2015). In addition, the literature argues that participation increases over time, as MSPs advance through different phases (Bizikova et al., 2012; Tenywa et al., 2012). Consequently, the first factor that we consider in the study is specific calendar-based periods, such as cultural events (e.g. festive seasons) and agricultural seasons. We investigate some of such periods, which are specified in detail in section 6.3.3.

The second temporal factor is based on the time period when R4Ds are implemented. Participation has been argued to increase as R4D implementation gets older (Biermann et al., 2007; Payne and Calton, 2002). Our review on the temporal factors indicated two major specific commonly discussed phasing. The first phasing is based on the changes in the R4Ds' objectives and innovations. R4Ds have multiple objectives – such as improving productivity, decreasing malaria incidence – and work on different innovations that can serve these objectives, such as developing new higher yield seed varieties or new mosquito traps. The stakeholder configurations that best fit these objectives and innovations are different, and a change in these also causes change in participation. As R4Ds focus on specific objectives and innovations for a period (hereafter R4D objective phases), these periods influence participation.

The second phasing is based on the type of work done on a single innovation. In R4Ds, innovation development goes through different periods. In general, initially, several potential innovations that can serve R4D objectives are discussed and prioritized. Later, R4Ds work on the prioritized innovations and improve them until they are disseminated and marketed to the stakeholders who can use them to improve their livelihoods. As these periods require the participation of different stakeholders to achieve different goals, a change in the periods influences stakeholder participation. In other words, the periods (hereafter, innovation development phases) influence participation.

In our review of temporal factors, we came across standard ways of capturing calendar-based periods and used a few of them, described in section 6.3.3. However, for periods of R4D objectives and innovation development phases, there are different arguments about how to define the phases. Therefore, we briefly synthesized multiple literatures and used the conceptualizations articulated in the following paragraphs.
R4Ds aim to achieve multiple livelihood objectives such as improving food security, nutrition and health status of smallholder farmers, natural resource management, empowering women and youth. As targeting these objectives will typically require more resources than they have at their disposal, R4Ds often identify entry points to focus their activities. In addition, each of these objectives can be achieved through different innovations, leading to a process of prioritization and focusing.

The R4D literature suggests several ways to phase these periods (Comby et al., 2014; Johnson et al., 2003; Nikitina et al., 2010; Roloff, 2008a, 2008b). For this study, we synthesized a four-phase approach (Table 6-2) for R4D objective phases. The phases start with (1) an entry phase, when stakeholders prioritize and select the objectives and innovations on which the R4Ds will initially focus (Adekunle and Fatunbi, 2012; Head, 2008; Johnson et al., 2003), followed by (2) a vertical progress phase, when

stakeholders generate deeper understanding and 'improve' selected innovations (Akpo et al., 2014), (3) a horizontal progress phase, when stakeholders focus on improving complementary innovations that are typically within the same value chain (Greenhalgh et al., 2004), or (4) a system progress phase, when stakeholders focus on improving the contribution of selected innovations to other objectives (Barlow et al., 2006; Svendsen and Laberge, 2005). Depending on the MSP participants' preferences, R4Ds might focus on vertical, horizontal, or system progress.

Table 6-2. Phases of different R4D objectives when participation is organized through MSPs.

Phase	Focus objective	Focus innovation	Description
Entry	N.A.	N.A.	Stakeholders discuss and prioritize objectives on which to focus in the R4D activities (i.e. focus objective), reflect on potential innovations that contribute best to the focus objective, and prioritize on which critical innovation to focus (i.e. focus innovation)
Vertical progress[a]	Entry objective	Entry innovations	Stakeholders apply, refine, and improve focus innovation prioritized in the entry phase
Horizontal progress[b]	Entry objective	Complementary innovations	Stakeholders identify and work on complementary innovations for achieving selected objectives
System progress	Different objectives	Entry innovations	Stakeholders work on improving the same innovations, contributing to other intervention objectives

a As the process of applying, refining, and improving the focus innovation requires deeper knowledge and experience about the focus innovation, we refer to this process as vertical progress.

b As complementary innovations are usually in the same value chains and work on these innovations crowds out the resources that can be used for vertical progress, we use horizontal progress to refer to the work on complementary innovations.

Numerous studies (Beers and Geerling-Eiff, 2014; Edquist, 2011; European Commission, 2014; Sauser et al., 2006) have referred to innovation development phases. Whereas Markard and Truffer (2008) identify multiple phases ranging from formation to market growth, Edquist (2011) proposes three phases: innovation generation, diffusion, and use. In policy interventions, a four-phase approach including generation of a promising innovation, showing a business case for it, adoption/adaption by first movers, and widespread adoption has been proposed (Beers and Geerling-Eiff, 2014).

The stepwise technology development assumption suggests that an innovation process starts with an idea, continues with basic research and technology formulation, followed by applied research, prototyping, and demonstration, and ends with early and full commercial application (European Commision, 2014). As these phases require different stakeholder capacities, their existence will imply different stakeholder configurations and different levels of participation during R4Ds (Johnson et al., 2003; Lamers et al., 2017). In brief, these phases of innovation development might affect participation. In this paper, we utilize the three phases suggested by Edquist (i.e. generation, diffusion, and use) because of their simplicity and generic character. To better accommodate innovation development in R4Ds, we add an initial phase in which the MSP goes through a participatory process of prioritization of innovations, resulting in the four phases described in Table 6-3.

Table 6-3. Innovation development phases in R4D.

Phase	Description	Typical activities
Innovation prioritization	MSP participants compare different innovations that will best fit the current objectives of the intervention and prioritize specific innovations on which to work	Listing of innovation options, consulting about the options, collective prioritization
Innovation generation	MSP participants design methods and implement practices in generating an innovation from scratch or from customization of intrinsic characteristics of an existing innovation to the geographical and institutional specifics of the location targeted by the intervention	Development of field protocols, field research, monitoring the results
Innovation diffusion	Generated innovation is further discussed with innovation actors outside the MSP in the broader innovation system	Workshop with public sector representatives, meetings with technical organizations
Innovation use	The awareness and capacities of innovation end users, such as farmers, private sector organizations, are targeted for increased use of innovation in livelihood systems	Farmer and business fairs, community information campaigns, provision of training, publication of dissemination materials

6.3 Methodological framework

6.3.1 Study context and study sites

We studied three MSPs in Uganda that were implemented under the CGIAR Research Programme on Integrated Systems for the Humid Tropics (Humidtropics), implemented between 2013 and end 2016. The programme covered four regions across the globe, one of which was East and Central Africa, including Uganda. Humidtropics aimed to improve livelihood systems by reducing rural poverty, increasing food security, improving nutrition and health, and strengthening the sustainable management of natural resources. To reach these targets, the programme focused on improving agricultural productivity, access to affordable food and consumption of nutritious foods, decreasing environmental harm from agriculture, and improving the innovation capacity of the local innovation systems (CGIAR, 2012). The programme aimed to optimize these outcomes to improve smallholder farmers' livelihoods.

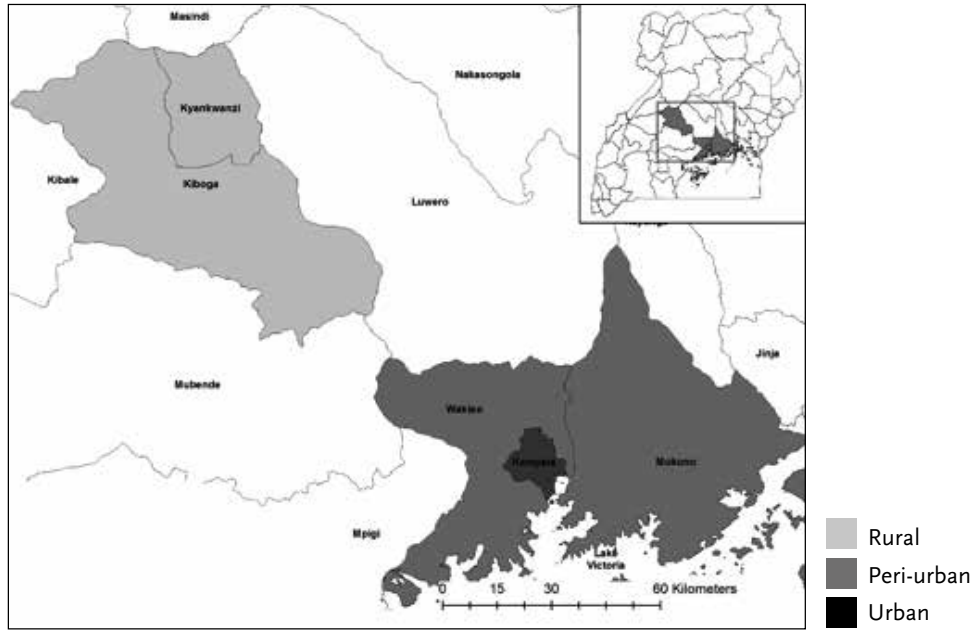
The Humidtropics programme in Uganda was organized through three MSPs. One of them was organized in Kampala – the economic and cultural capital of Uganda – another one in Kiboga and Kyankwanzi Districts, 123 and 155 km northwest of Kampala respectively, and the third one in Wakiso and Mukono Districts, 16 and 24 km east of Kampala, respectively (Figure 6-1). The programme included a diverse set of events, including meetings, field visits, experiments, capacity-building workshops, and promotion events. The implementation and management of the events were supported by teams hosted within the organizations managing Humidtropics. The events in three sites kicked off in August 2013 with a big event, after which they were officially established in February 2014. The implementation and management teams included (1) champions – influential people who were financially and conceptually supportive of the MSPs in the organization leading the programme in Uganda – and district opinion leaders, (2) facilitators, both at national and at district scale, (3) organization and monitoring staff employed by the intervention working across the programme and their local assistants.

6.3.2 Data collection

Data for the study were collected throughout the period 2013 to 2016, using two short surveys from the Learning System for Agricultural Research for Development (LESARD) (Sartas et al., 2017). The first survey was a LESARD Participant Profile (Annex 6-1), which recorded the characteristics of individuals participating in the R4D events. The participant profile was administered to all stakeholders who participated more than once in the events. The questions included the stakeholders' organizations, their professional background, expertise subjects, scales of operation and role in the value chain group. The second survey was a LESARD Event Log (Annex 5-1), which recorded

information about all the events in the R4D intervention. These included formal MSP meetings, but also smaller informal meetings where a subset of stakeholders met to pursue specific tasks agreed upon by the MSPs, field visits, workshops, and promotional events. It covered location, start and end dates, event type, and organizations funding different expenses of the events, as well as the information tools and documentation applied to the event. For the variables related to event types, minutes and audio and video materials were used to validate the content of the event.

Figure 6-1. Map of Uganda indicating the locations of the three studied MSP



6.3.3 Data analysis

Data analysis was organized in two ways, namely, descriptive statistics and linear (time-series) regression. Descriptive statistics were used to express changes in participation in nominal and in unique terms throughout the R4D intervention. Linear regression, using ARIMA (Wei, 1994) in SPSS v.23, facilitated the modelling of factors affecting changes in participation. Significant model coefficients are reported in sub section 6.4.3. Analysis of participatory observations provided additional insights that enabled interpretation and discussion of our results. Our study included two sets of variables, namely, participation and factors affecting participation (Table 6-4). Participation was measured by counting the number of stakeholders at an event, i.e. unique stakeholders.

To study factors affecting participation, we focused on seven major factors, i.e. (1) geographical location, (2) funding, (3) human resources for the management and implementation of the MSP, (4) MSP events, (5) the phases of R4D development, (6) the phases of the innovation development process, and (7) other time aspects. Each of these factors was investigated by analyzing relevant variables (Table 6-4).

Table 6-4. Factors affecting participation.

Factors	Variables	Variable descriptions
Locational factors		
Geographical location	Rural/urban characteristics of the location	The locations in which the stakeholders operate, taking different integer values for Kiboga-Kyankwanzi (rural), Mukono-Wakiso (peri-urban), and Kampala (urban)
Intervention factors		
Funding	Share of funding	Share of funding not provided by the intervention (co-funding by other actors) for different events, taking rational number values
	Share of specific intervention funding	Share of funding provided by the intervention for different expenditures including mobilization, transportation cost, food, daily allowance, event venue, facilitation, taking rational number values for each type
Human resources	Number of individual MSP intervention staff	Number of individual MSP implementation and management staff members participating in the events, including champions, facilitators, organizers, and monitors
Events	Type of event (detailed)	Type of event, including intervention implementation meeting, platform meeting, platform sub-group meeting, reflection meeting, capacity building event, field setup, field monitoring, researcher meeting, promotion event, fundraising event, specific events organized by MSP members and preparation events, taking an integer value for each type
	Type of event (research and delivery)	Type of R4D event classified into three groups based on focus content of the event, i.e. (1) research, (2) delivery, i.e. usage of research findings or (3) mixed, taking an integer value for each type
Temporal factors		
R4D objective	Phase of the event	Phase of periods based on different objective-innovation bundles, covering prioritization, vertical progress, horizontal progress, and systems progress, taking an integer value for each phase. When the content of the event includes more than one progress event, it is categorized as multiple-progress
Innovation development process	Phase of the event	Phase of the innovation development process, covering prioritization, generation, diffusion, and use, taking an integer value for each phase
Time	Specific periods	Long non-working periods such as Christmas and Easter breaks, national holidays, taking a binary value for each specific period

We calculated rural/urban characteristics of the location by checking the administrative classification of the location provided as a response to the location question in the LESARD Event Log. Share of funding in general and in specific terms was calculated by checking the responses given to the fund provision question in the Event Log. Each cost item, i.e. mobilization, transportation cost, food, daily allowance, event venue, and facilitation, was given equal weight. Type of event was identified using the response given to multiple selection event type questions in the Event Log. Phases of periods based on different objective-innovation bundles and innovation development processes were identified using the responses given to the event type question and validated with controlling the minutes and pictures of the events. Other time periods, i.e. production seasons and special breaks, were identified by the stakeholders from the social and geographical specifications of the locations where the MSP was active.

6.4 Results

6.4.1 Participation and changes in participation

Participation in 411 R4D events ranged between a monthly average of 4 and 51. The average participation up to the tenth month after MSP establishment (Period A) was 31 per month (Figure 6-2). Between Months 11 and 18 (Period B) and between Months 22 and 26 (Period D), there was an increase in average participation (we use periods A to E to summarize a collection of consecutive months. The periods are formulated using the observed visual patterns in participation; they are not the result of any statistical inquiry). In Period B, the average monthly participation was 173, and it was

288 in Period D. Between Months 19 and 21 (Period C) and from Month 27 onwards (Period E), average participation per month was lower than in the preceding months, with averages of 157 and 112.

During the three years of implementation, 4767 nominal and 1123 unique stakeholders participated in the R4D. Nominal and unique participation presented similar patterns across the MSP periods. During Periods A, C, and E, participation in the MSPs was mostly stable, except during Months 6 and 31 (Figure 6-2). During Periods B, and D, participation increased. In Period B, the increase accelerated continuously, whereas in Period E it peaked in Month 24. In the first half of Period A, participation stagnated.

6.4.2 Factors affecting participation and changes over time

Location-related, intervention-related, and temporal factors were significant in affecting participation (Table 6-5). In terms of locational aspects, geographical location was an influential factor. Participation was relatively lower in urban areas, medium in peri-urban areas, and higher in rural areas. Regarding the intervention-related factors, human resources, i.e. participation of facilitation, organization, and monitoring staff, were significant. Higher investments in human resources were positively related with stakeholder participation. Among temporal factors, phases of R4D objectives and innovation development were significant. Participation was higher in later phases of both temporal factors (Table 6-4).

Among the intervention-related factors, (1) share of funding provided for the events by the R4D project, (2) share of specific intervention funding to different expenditures including mobilization, transportation cost, food, daily allowance, event venue, facilitation, (3) type of event based on detailed event type (Table 6-3), (4) type of event based on research and delivery, and (5) participation of champions were insignificant. Among temporal factors, (1) production season and (2) other special periods such as long holidays were insignificant.

6.5 Analysis and Discussion

6.5.1 Is participation dynamic?

Our study indeed confirms that MSP participation is dynamic, as found also in previous studies. The participation dynamics presented a cyclical pattern in the cases that we investigated. Periods of stagnation in the number of new stakeholders were followed by periods of expansion (Figure 6-2). Participation in both nominal and unique terms was mostly stable in Periods A, C, and E and changing in Periods in B and D. These changes in participation are partially caused by the combined effect of the sig-

Figure 6-2. Number of nominal participants in Uganda MSPs. Nominal and unique participation in MSPs had similar patterns throughout the intervention period. Stable periods (A, C, E) were followed and preceded by periods of increase (B, D).

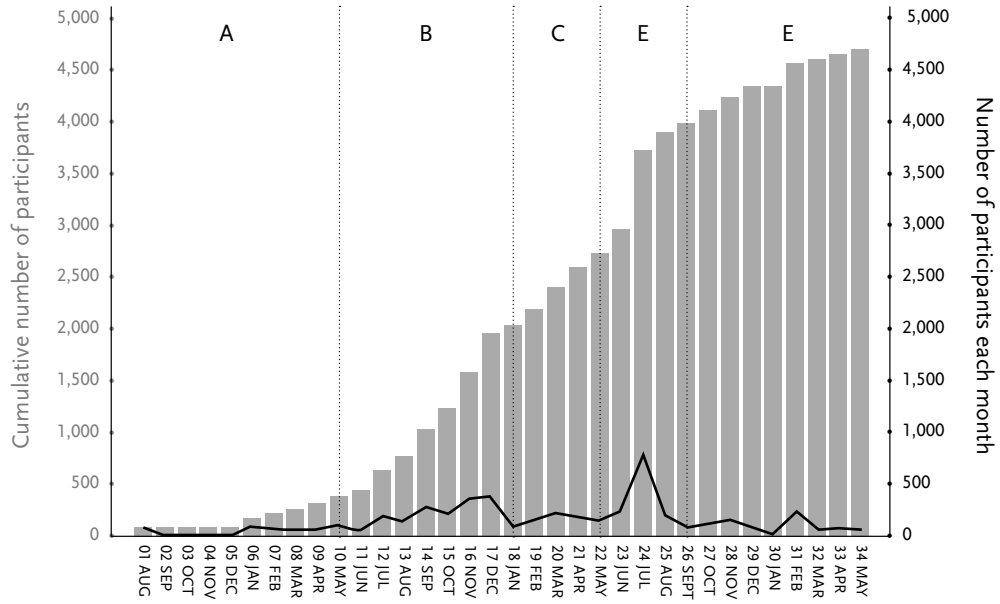


Table 6-5. Linear regression results for participation. Numbers in the third column represent the coefficients for statistically significant factors of participation with 0.01 (**) and 0.05 (*) confidence levels. Only significant factors are included.

Factors	Variables	Model coefficient	Description
Locational factors			
Geographical location	Location of event on rural-urban gradient	-3.37**	Participation is relatively low in urban locations, medium in peri-urban locations, and high in rural locations
Intervention factors			
Human resources	Facilitator	2.11**	Participation is high at events when there are facilitation staff
	Organization and monitoring	1.19*	Participation is high at events when there are organization and monitoring staff
Temporal factors			
R4D objectives	R4D objective phase	4.45**	Participation is relatively low in entry phase events, medium in vertical progress, and higher in horizontal and system progress events
Innovation development	Innovation development phase	3.48**	Participation is relatively low in prioritization phase events, medium in generation events, and higher in diffusion and use events
Model information			
Time lag	AR (1)	0.46**	
	R Square	0.36	

nificant factors discussed in section 6.4.2 that led to these dynamic aspects. As the explanatory power of the model is 36% (Table 6-5), other important factors beyond the scope of this study contributed to the patterns observed in these periods.

Our study showed that total participation increased both in nominal and in unique terms. More than 1100 unique stakeholders participated in the three MSPs (366 per MSP), totalling approximately 4750 nominal participations (Figure 6-2). This confirms that both nominal and unique participation during R4Ds can increase when it is organized through MSPs (Roloff, 2008b; Zornes et al., 2016). As these numbers reflect the stakeholders that participated in two events or more, the outreach of R4Ds that apply the MSP approach when participation is organized through MSPs is likely to be higher than the numbers reported in this study. However, in non-cumulative terms, participation did not show a trend. In other words, average participation in a month was not higher or lower in the later period of the intervention in comparison to the earlier period.

6.5.2 How was participation influenced by location-related, intervention-related, and temporal factors?

In the MSPs studied, various location-related, intervention-related, and temporal factors influenced participation.

Location-related factors

The locational factor investigated, geographical location along a rural–urban gradient, was significantly related to participation (Table 6-5). Participation was highest in Kiboga-Kyankwanzi, medium in Mukono-Wakiso, and lowest in Kampala. As Kiboga and Kyankwanzi are rural districts far from Kampala, and Mukono-Wakiso is a relatively close peri-urban area (Figure 6-1), we can argue that rurality maybe a relevant aspect that makes location significant. The decrease in participation along the rural–urban gradient confirms the locality argument. In other words, the higher interest of the local communities and the local media based in the rural areas might lead to higher participation in rural areas. The decrease in participation along the rural–urban gradient might be also due to the availability of alternative options for stakeholders. Stakeholders might have more opportunities and demands to allocate their time in the urban locations in comparison to peri-urban and rural locations where these opportunities are scarcer (Chambers, 1994; North and Smallbone, 2000; Tacoli, 1998)

Intervention-related factors

Our study also showed that human resource allocation to manage and implement the MSP was significantly correlated to participation (Table 6-5). Among the specific human resource contributions, the availability of facilitation, organization, and moni-

toring was significant. Although statistical relations do not necessarily imply causality, the results support the commonly reported important role of facilitation for participation (Beers and Geerling-Eiff, 2014). Although not frequently referred to in the literature, organization and monitoring are mentioned as important in many events. For instance, a field researcher in the Mukono-Wakiso platform in Month 13 mentioned that 'Provisions of Mukono local administration for organizing of field and farmer visits helped to reach many farmers in different subcounties.'

Funding provided by the R4D intervention (in this case Humidtropics) to events as a share of the total cost of the events was not correlated with participation. Similarly, specific funding for mobilizing stakeholders to participate in the event, transportation of the stakeholders to and from the venue, provision of a daily allowance and food to participating stakeholders, using the event venue, and facilitation of the event were not significantly correlated with participation. This result does not confirm the arguments of some earlier studies (Aw-Hassan, 2008; Faysse, 2006; Johnson et al., 2003) regarding the positive relation between funding and participation. It also indicates that monetary incentives might not be sufficient to increase participation, as opposed to the arguments in some of the literature (Foran et al., 2014; Gupta, 2014).

One reason why funding is not significant could be that the amount of funding provided by the R4Ds is not sufficient to cover the opportunity costs of participation. MSPs consist of a continuous set of activities, and influencing the MSPs' agenda might necessitate participation in the R4D events multiple times. When combined, participation in multiple events can create a large demand on stakeholders' time. The time spent on the MSPs could be used on many other activities that would give stakeholders more direct benefit. Earlier studies have indicated that this may be particularly relevant for private sector stakeholders (Lamers et al., 2017).

Type of event organized by the R4Ds through MSPs was not significantly correlated with participation. Participation was not significantly different between research and delivery events. In addition, participation varied for all 12 event types over the course of the R4D interventions. One possible reason for insignificant results might be that geographical location where the event was organized was more relevant for participation than the type of event. The same type of event might attract different participation in rural and urban areas. This was indeed the case in our study. On average, both research and delivery events attracted more participation in rural areas (18.5 and 24.2 persons, respectively, per event) than in urban areas (6.6 and 6.7 persons, respectively, per event). Similarly, in 9 of the 10 events organized both in rural and in urban areas, participation was higher in rural areas.

Temporal factors

In our study, calendar-based periods were not significantly related to participation. Production season and specific time periods like the December festive season were insignificant. However, both R4D objective and innovation development phases were significant (Table 6-5). This confirms findings from the literature in which change in MSP participation over time is related to phases of R4D objectives and innovation development (Beers and Geerling-Eiff, 2014; Comby et al., 2014; Edquist, 2011; European Commission, 2014; Johnson et al., 2003; Nikitina et al., 2010; Roloff, 2008b; Sauser et al., 2006) and verifies that process models can explain the changes in participation in R4Ds.

Although agriculture was central in our empirical cases, the high dependence of agriculture on climatic seasons did not result in a significant effect of calendar-based periods. In addition, given that the influence of calendar-based periods in other R4Ds focusing on natural resource management, health, and environmental dimensions of livelihoods would be less seasonal than agricultural dimensions, which present strong seasonality (Sautier et al., 2017; Ohe, 2010), it is high likely that R4Ds focusing on these dimensions will have lower sensitivity towards calendar-based period. Therefore, it can be argued that MSPs change the nature of participation in R4Ds and align it with other temporal dynamics of multi-stakeholder processes. Thus, prioritizing R4D objective and innovation development phases rather than calendar periods in the design and implementation of R4Ds with MSPs has the potential to improve the impact of R4Ds.

6.6 Conclusion

We have shown that participation in R4D events is dynamic both in nominal and in unique terms. Participation fluctuates throughout R4D implementation. Our study has also indicated that location on the rural–urban gradient, human resources allocated for facilitating, organizing and monitoring, and phases of R4D objective and innovation development influence participation in R4D events.

Our study has shown that R4Ds are conducive to increasing the cumulative number of stakeholders participating in the events of R4Ds. However, the increase is not valid for average terms. Moreover, locational and temporal factors might have a higher influence than intervention factors, implying that participation is more autonomous in nature than induced or influenced by the R4D intervention. We conclude that MSP contribution to the performance of R4Ds in increasing participation is conditional, depending on the duration of the participation necessary to achieve the R4D objec-

tives as well as on the locational and temporal context in which the R4D intervention is operating.

The findings in our study imply that using MSPs can help R4Ds to reach a high number of stakeholders. Consequently, MSPs can be instrumental in reaching R4D objectives that require high audience numbers, such as dissemination of information and distribution of products and materials. However, they are not effective in increasing average participation. Thus, if the R4D objective requires continued participation by a high number of stakeholders, such as enhancing collective action or supervising R4D events, the contribution of MSPs is limited. In addition, our study has shown that participation fluctuates or is cyclical. Therefore, the potential contribution of MSPs to R4Ds changes over time. Consequently, monitoring participation and scheduling R4D events based on participation might be necessary to make best use of the MSP approach.

6.7 Acknowledgements

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6.8 Annexes

Annex 6-1 Participant Profile

1. Please specify your surname and name.
2. Please select the country the event is organized.
3. Which organizations do you present?
4. What are your professions?
5. What are your expertise subjects?
6. Please choose the options that describe you. Please select as many as possible.
   - o Female
   - o Male
   - o Youth
   - o Adult
   - o Single
   - o Married
7. To which stakeholder group do you belong?
   - o Input suppliers (seed, fertilizer)
   - o Farmer, primary producer
   - o Trader or broker
   - o Processor
   - o Retailer or wholesaler
   - o Consumer groups
   - o Extension officers/Public local technical staff
   - o Other business
   - o Farmers' organizations
   - o Local or national researchers
   - o International researchers
   - o Local NGO
   - o Local politician
   - o Local media
   - o National politicians
   - o National NGO
   - o National media
   - o International NGO
   - o Other:

7

Discussion and Synthesis

7.1 Introduction

This thesis explored the contribution of MSPs to the performance of R4D interventions. In doing so, it contributes to scientific and development debates about whether and under which conditions MSPs increase the performance of R4D interventions.

The empirical basis of the thesis consists of 10 MSP cases implemented under one R4D program across four countries in Eastern and Central Africa for approximately three years. Although there are differences in the specific contexts under which the MSPs were operationalized, the analysis of the 10 cases using an action research-based mixed-methods approach indicated some similarities in terms of their contribution and the factors that influence this.

7.1.1 Summary of the thesis content

In the thesis, I studied various initial characteristics of process outputs and drivers, changes in them, and various factors explaining the changes. In relation to this, a number of concepts and variables are used across this thesis. They are reiterated and briefly described in Table 7-1.

Table 7-1. Brief description of central concepts used in the thesis.

Concept	Category	Sub-category	Description
Interface of change	Process driver	Participation	A stakeholder attending to an R4D event
		Shared understanding	The converge of preferences among the stakeholders on different professional issues
		Engagement	Level of involvement of stakeholders with R4D activities
		Learning	Knowledge of stakeholders on innovations targeted by the interventions and how they are interacting
	Process outputs	Collaboration	A relationship in which two stakeholders work together
		Knowledge exchange	A relationship in which two stakeholders exchange knowledge
		Influence spread	A relationship in which one stakeholder has more agenda setting and decision influence vis-à-vis the other
		Intervention outputs	(N.A., because not studied)	Tangible outputs, i.e. products, services, publications, laws, generated by the interventions
		Livelihood outcomes	(N.A., because not studied)	Results of the intervention and process outputs in the livelihood system, such as increased income, decreased carbon emission
Livelihood impact	(N.A., because not studied)	Ultimate objective or 'endgame' of R4D interventions such as reduced poverty, slower global warming	
Factors	Intervention factors	Human resources	People who are paid by intervention
		Funding	Money spent for achieving R4D objectives such as organizing MSP meetings
		Events	Activities organized to achieve specific objectives of the R4D such as field visits, trainings, meetings
		Focused livelihood outcomes	Type and the name of the specific livelihood outcomes R4D intervention focus in a site
	Contextual factors	Country	The countries targeted by R4D intervention
		Rural–urban gradient	The rurality of the locations R4D events are organized
		Initial configuration of stakeholder networks	Global and local structures of stakeholder networks and ego network characteristics of central stakeholders
	Temporal factors	Phases in terms of the innovations focused by the R4D intervention	Periods in which R4D intervention focus on entry innovation and other related innovations
		Innovation development phases	Periods in which R4D intervention focus on specific innovation development objective
		Production seasons	Production seasons of the focus commodity of MSP, such as dry and wet seasons
		Specific periods	Long non-working periods such as Christmas breaks and national holidays

Table 7-2. LESARD tools used to manage data used in the thesis.

Sub-category	Documentation	Analysis
Participation	Attendance lists, photos, videos, participant profile	Trend analysis
Shared understanding	Learning log, event log	Text analysis, trend analysis
Engagement	Learning log, event log	Text analysis, trend analysis
Learning	Learning log, event log	Text analysis, trend analysis
Collaboration	Participant profile, network profile*	Social network analysis
Knowledge exchange	Participant profile, network profile	Social network analysis
Influence spread	Participant profile, network profile	Social network analysis
Human resources	Intervention recruitment documents, photos	Descriptive statistics
Funding	Intervention spending records, interviews	Descriptive statistics
Events	Event log	Descriptive statistics
Focused livelihood outcomes	Intervention proposals, monitoring and evaluation documents	Descriptive statistics
Country	Event log	Descriptive statistics
Rural–urban gradient	Event log, administrative maps of targeted countries	Descriptive statistics
Initial configuration of stakeholder networks	Network profile	Social network analysis
Phases in terms of the innovations targeted by the R4D intervention	Intervention monitoring and evaluation records, interviews	Text analysis
Innovation development phases	Intervention monitoring and evaluation records, interviews	Text analysis
Production seasons	Agricultural calendars for each intervention site, interviews	Descriptive statistics
Specific periods	Official holiday register for each country, interviews	Descriptive statistics

7.1.2 Brief description of the thesis process

I applied three basic steps to organize the thesis research: developing a data management system, studying process outputs, and studying process drivers.

Developing a data management system for studying the contribution of MSPs to intervention performance

The first step of the thesis research was the development, testing, and implementation of a methodological framework and accompanying toolset for data collection, analysis, and reporting. As capturing the contribution of MSPs requires a comprehensive, systematic, and dynamic framework that could not be found in the literature, I designed the Learning System for Agricultural Research for Development (LESARD). LESARD sets the foundation for the methodological choices made in the empirical chapters and provides background on the overall research approach for R4D researchers, interventions managers, and practitioners (see Chapter 2).

LESARD initially consisted of four major building blocks. During the thesis process, the building blocks were reorganized; currently, LESARD consists of six blocks, two of which are planning tools and four implementation tools. These six blocks are:

1. Theory of change
2. Results framework
3. Documentation toolkit
4. Reporting toolkit
5. Analysis toolkit
6. Dissemination toolkit

The two planning tools are theory of change and results framework. The theory of change helped MSP participants to describe the context of the intervention and to articulate relevant process outputs, their drivers, intervention outputs, livelihood outcomes, impact and intervention aspects, as well as the relations between them (see Chapter 2). At the same time, it defined what to study and framed the data needs of the research. The results framework helped to specify all instances for data collection and data analysis and allowed for the efficient use of resources for data management. Specifically, for each item presented in the theory of change, the results framework showed the R4D event where data had to be collected, the indicators to be measured, the operational questions to inquire about the indicators, the documentation tools in which the questions are presented, the reporting tools for storing the data collected by documentation, the analysis tools for the reported data, the results into which the data feed, the audiences for the results, and finally the dissemination tools for the results presented (see Chapter 2).

The four LESARD implementation toolkits are documentation, reporting, analysis, and dissemination. The documentation toolkits are categorized in four layers based on speed of reporting and analysis. The first layer consists of structured surveys, the results of which can be reported and analyzed quickly. The second layer consists of tools generating semi-structured text data. The tools in the third layer allow photos, audio, and videos to be captured, and the fourth and the last layer consists of e-mails and interview records. The data for the thesis were mostly collected using tools in the first and second layers. To this end, trained monitors – intervention staff responsible for LESARD data collection – participated in most of the R4D events and collected and reported the data using the LESARD tools that I developed. To study the different concepts and sub-categories listed in Table 7-1, I used the documentation, reporting, and analysis tools presented in Table 7-2.

Studying process outputs

The second step of the thesis research was to understand process outputs better in terms of the influence of MSPs on the configuration of innovation networks. The second step was framed by Research Question 1, i.e.

> *What are the initial characteristics of process outputs? How do they change following an R4D intervention with MSPs? Which factors trigger the changes?*

This step consisted of two stages. In the first stage, the theoretical link between the configuration of innovation networks and MSPs was established. Various actor configurations that provide information about the potential of an innovation network for generating innovations and increasing their use at scale were articulated by using the collaboration, knowledge exchange, and influence networks existing in the locations targeted by the R4D program (Chapter 3). The first stage showed that innovation networks can be used for studying the performance of R4D interventions with MSPs, and that social network analysis methods can provide important insights on how MSPs fit or influence innovation networks. The second stage investigated the influence of MSPs on innovation networks in terms of the same process outputs: collaboration, knowledge exchange, and influence networks (Chapter 4). The initial actor configurations of the networks were compared with the configurations following the R4D program, and differences were identified using social network analysis and logistic models. Chapter 4 showed that MSPs do not necessarily lead to positive changes in the performance of R4D interventions. It also showed that, despite the contextual differences in the locations in which R4D interventions with MSP were implemented, some factors such as funding provided to the participating organizations can explain the changes in the networks across different countries and locations.

Studying process drivers

The last step of the thesis research focused on process drivers, i.e. the major processes – participation, shared understanding, engagement, and learning – that may lead to changes in collaboration, knowledge exchange, and influence spread. It was framed by Research Question 2.

> *What are the initial characteristics of process drivers? How do they change following an R4D intervention with MSPs? Which factors trigger the changes?*

The third step was made up of three stages. In the first stage, a literature review was conducted to identify the specific processes that were shown to influence the contribution of MSPs to R4D intervention performance. The first stage indicated that participation, shared understanding, engagement, and learning are the major process drivers influencing MSP performance across multiple intervention types and multiple intervention domains. The first stage concluded that these four processes can be used to study the contribution of MSPs to R4D intervention performance (Chapter 5). The second stage focused on the overall contribution of MSPs to participation, shared understanding, engagement, and learning across different contexts. To this end, all Humidtropics MSPs were studied using a mixed-methods approach, whereby text analysis was used to create quantitative indicators (Chapter 5). The second stage showed that all four processes are dynamic and that they experience ups and downs during the implementation of the R4D intervention. In addition, this stage showed that the factors that contribute to the dynamics of the processes are process specific. The factors that affected participation differed from the factors that influenced learning. The third and last stage of step three was to investigate participation in more detail. This stage focused on understanding participation better in nominal and unique terms in three MSPs operationalized in Uganda by using time series analysis. It showed that MSPs can increase the participation of groups of stakeholders and that locational, intervention-related, and temporal factors influence the contribution of MSPs to participation (Chapter 6).

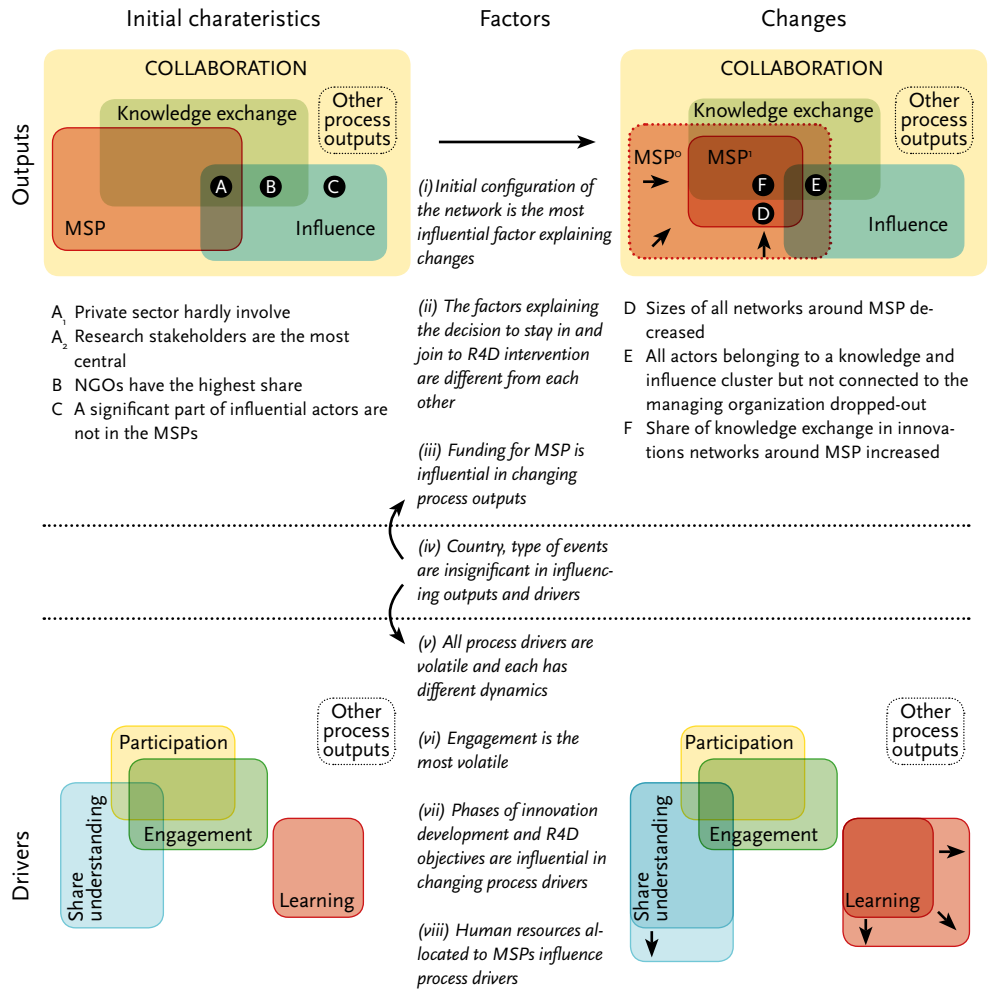
In this final chapter, I use a stepwise approach to present and discuss the general learning from the thesis in more detail (Figure 7-1). First, I present a graphic overview of the results generated in the thesis (section 7.2, Figure 7-2) and briefly describe each specific result. Then, I consolidate these findings into four main conclusions and position these in the broader literature (section 7.3). Subsequently, I discuss the implications of the thesis for future research and for development practice (section 7.4). The thesis ends with some final reflections.

Figure 7-1. Structure of Chapter 7.

7.2 The results of the thesis

In the thesis research, I generated 14 major results and used them to synthesize the findings. Figure 7-2 summarizes these results. The graphics presented on the left and right sides present the initial characteristics and the changes inquired by the research questions, respectively. In the upper part of Figure 7-2, the graphic boxes represent the boundaries of (partially overlapping) networks involved in specific process outputs, and the letters are used to locate and position specific results in relation to these. The middle column represents the factors related to changes in the characteristics of both process outputs and their drivers. In the lower part of Figure 7-2, the graphic boxes represent the specific process driver. Overlapping drivers are empirically related to each other. In this section, I briefly describe and articulate the results to provide a foundation to formulate the findings.

Figure 7-2. Summary of the results.



7.2.1 Observations regarding initial characteristics

A1. Private sector stakeholders are hardly involved

In all the networks presenting three different process outputs and among the stakeholders involved in MSPs, the number of private sector stakeholders was the lowest among all the types (i.e. farmer, NGOs, government, business, research). Most platforms did not include private sector parties at all; a few platforms involved one or two private sector stakeholders (see Chapter 3, section 3.3.1).

A2. Research stakeholders are the most central
In the networks involved in collaboration, knowledge exchange, and influence spread, stakeholders with the highest network centrality statistics were research stakeholders. In addition, among the MSP participants, research actors had the highest number of connections with other members of the MSP (see Chapter 3, sections 3.3.1 and 3.3.2).

B. NGOs have the largest share
In terms of type of actors, NGOs were the most represented in collaboration, knowledge exchange, and influence spread networks. However, NGOs were less represented than research stakeholders in all MSPs, and they were also less represented than government stakeholders in some of the MSPs studied (see Chapter 3, sections 3.3.1 and 3.3.2).

C. A significant portion of the influential stakeholders were not involved in the MSPs
Across the 10 MSPs, we observed that a significant proportion of highly influential stakeholders were not involved in the MSPs. This contrasts with high centrality stakeholders in networks for collaboration and knowledge exchange (see Chapter 3, sections 3.3.1 and 3.3.2).

7.2.2 Observations regarding changes

D. Sizes of all process output networks around MSPs decreased
The overall size of all networks surrounding MSPs (i.e. those related to collaboration, knowledge exchange, and influence spread) decreased, indicating that processes of (self) selection took place. The magnitude of the decrease varied among the MSPs (see Chapter 4, section 4.3.2).

E. All actors belonging to a knowledge or influence spread cluster that did not have a direct linkage with the lead organization dropped out of the MSPs
Before the implementation of the MSPs, knowledge exchange and influence spread networks consisted of some sub-clusters, involving groups of organizations that were not initially connected to the lead organization. However, the stakeholders that were involved in these sub-clusters left collaboration, knowledge exchange, or influence spread networks surrounding the MSPs in the course of their implementation (see Chapter 4, section 4.3.2).

F. The share of stakeholders involved in knowledge exchange increased
Although the number of stakeholders involved in collaboration, knowledge exchange, and influence spread around the MSPs decreased, the decreases were not proportional. The decrease was smallest for stakeholders exchanging knowledge. Therefore, the share of stakeholders exchanging knowledge increased in relation to other categories of stakeholders (see Chapter 4, section 4.3.2).

7.2.3 Observations regarding factors influencing change

1. *The initial configuration of the networks is the most influential factor in explaining the changes in process outputs*
Among all the factors that can potentially influence the changes in the process outputs, the initial configuration of networks (i.e. the number of connections a stakeholder has at the start, the total number of organizations in the network) has the largest effect on the changes in process outputs (see Chapter 4, section 4.3.3).

2. *The factors explaining the decision to stay in or join the R4D intervention are different from each other*
Different factors influenced the decision to stay and join R4D interventions. In terms of the decision to stay, the most significant factor was the total number of stakeholders in the network. The tendency to leave the MSP was lower if the number of stakeholders collaborating, exchanging knowledge, and influencing was higher. However, the tendency to join the MSP was higher for denser collaboration, knowledge exchange, and influence spread networks (see Chapter 4, section 4.3.3).

3. *Funding for MSP is influential in changing process outputs*
Funding allocated to MSPs appeared to influence changes in collaboration, knowledge exchange, and influence spread networks. Whereas funding to organizations had a significant influence on sustaining ongoing linkages in networks, funding to MSP events encouraged establishing linkages with new actors (see Chapter 4, section 4.3.3).

4. *Country, type of events are insignificant in influencing outputs and drivers*
The analysis in Chapters 4 and 5 indicated that the specific country (Burundi, DRC, or Rwanda) or the type of event (see Annex 5-5, Chapter 5) organized had no significant influence on changes in process outputs and their drivers (see Chapters 4 and 5, sections 4.3.3 and 5.3.2).

5. *All process drivers are volatile and each has different dynamics*
All the process drivers investigated in the thesis (i.e. participation, shared understanding, engagement, and learning) had some peculiar and distinct dynamics. For instance, participation demonstrated a cyclical pattern, whereas learning tended to evolve along a gradual line (see Chapter 5, section 5.3.1).

6. *Engagement is the most volatile process driver*
   Among the four drivers, stakeholder engagement is the most volatile. Stakeholders' average engagement with intervention events moved between 2 and 4.5, which amounts to twice the amount of variability compared to the other process drivers (see Chapter 5, section 5.3.1).

7. *Phases of innovation development and R4D objectives are influential in changing process drivers*
   Temporal factors that relate to the nature of innovation processes and the choices of R4D interventions regarding objectives were significant in explaining the changes in process drivers. Other temporal factors (e.g. agricultural seasons) did not appear to have a significant influence on process drivers (see Chapter 6, section 6.4), and the number of days since inception was influential for some drivers but not for others (see Chapter 5, section 5.3.1).

8. *Human resources allocated to MSPs influence process drivers*
   The human resources allocated to MSPs (i.e. the deployment of staff such as facilitators, organizers, and monitors) influenced the dynamics of participation in that participation was higher when more staff were involved (see Chapter 6, section 6.3).

7.3 Conclusions

From the results portrayed in Figure 7-2, I have consolidated four major conclusions regarding the contribution of MSPs to the performance of R4D interventions. They are formulated and linked to the broader literature below.

7.3.1 CONCLUSION 1

The initial configuration of stakeholder networks in which MSPs operate is highly influential in shaping the contribution of MSPs to the performance of R4D interventions

Chapters 3 and 4 suggest multiple results supporting the major role of initial configurations of stakeholder networks in terms of the contribution of MSPs to the performance of R4D interventions. Research stakeholders, who were more central in the collaboration process, and NGOs, which had the highest level of involvement, preserved their status during the implementation of the intervention (A, B). Likewise, there was no major change in the role of private sector stakeholders (A). In addition, Chapter 4 indicated that stakeholders who already had more connections with other stakeholders were significantly more likely to stay than stakeholders with fewer connections.

In other words, the thesis research supports the earlier findings on the important role of initial conditions in affecting the contribution of MSPs to R4D interventions (Van Paassen et al., 2014; Schut et al., 2018; Hermans et al., 2015). However, this conclusion contrasts to some extent with those that point to the importance of other types of initial contextual conditions, such as country-specific enabling environments (Spielman et al., 2010) or the agro-ecological contexts in which agriculture takes place (Assaye et al., 2015). By and large, the influence of such contextual conditions was not confirmed in this thesis. Nevertheless, Chapter 5 indicated that location on a rural–urban gradient was influential, but only in relation to one of the process drivers studied (participation). Therefore, I claim that the initial configuration of stakeholder networks in which MSPs operate is highly influential in shaping the contribution of MSPs to the performance of R4D interventions.

7.3.2 CONCLUSION 2

The factors that can be controlled by the intervention have limited influence on the contribution of MSPs to the performance of R4D interventions

MSP literature focusing on R4D interventions has studied a variety of factors that can be influenced by interventions (Schut et al., 2016b; van Mierlo and Totin, 2014; Faysse, 2006; Home and Rump, 2015; Warner, 2006a; Borgatti, 2006; Head, 2008). However, among the potential intervention factors investigated in Chapters 3 to 6 (i.e. funding allocated by interventions, human resources backstopping implementation of MSPs, types of problems targeted by MSP, type and number of events organized by the intervention) only the first two had a significant effect on several process outputs and/or process drivers. Funding was influential in terms of influencing process outputs (iii) and human resources influenced process drivers (viii). Others were not significant. None of the specific types of funding (i.e. to organizations, to events, to simple projects whose spending decisions were made collectively by MSP participants) or human resources (i.e. champions, facilitators, monitors, or organizers) was significant individually across outputs or their drivers. Therefore, I claim that the factors that can be controlled by the intervention have limited influence on the contribution of MSPs to the performance of R4D interventions.

7.3.3 CONCLUSION 3

Temporal aspects related to innovation and intervention stages influence the contribution of MSPs to R4D intervention performance

R4D literature on MSPs has indicated that time can influence the workings of MSPs (Aaltonen and Kujala, 2010; Barrientos et al., 2003; Assaye et al., 2015). Chapters 4 and 5 show that all process drivers investigated are volatile (v) and that some of them (i.e. participation and engagement) have cyclical patterns. However, the temporal factors that influence the drivers are not based on time periods. The results

in Chapter 4 indicate that calendar days, agro-ecological seasons, administrative or social events did not have a significant influence on process outputs. Nonetheless, intervention and innovation processes have their own temporal dimension, i.e. they pass through different stages that are uncorrelated with linear time. Innovations pass through stages of prioritization, generation, diffusion, and use, and interventions pass through stages of entry, vertical, horizontal, and system progress. Indeed, such innovation- and intervention-related stages did have an influence on the process driver, participation (see Chapter 6). Therefore, I claim that temporal aspects related to the innovation and intervention stages influence the contribution of MSPs to R4D intervention performance.

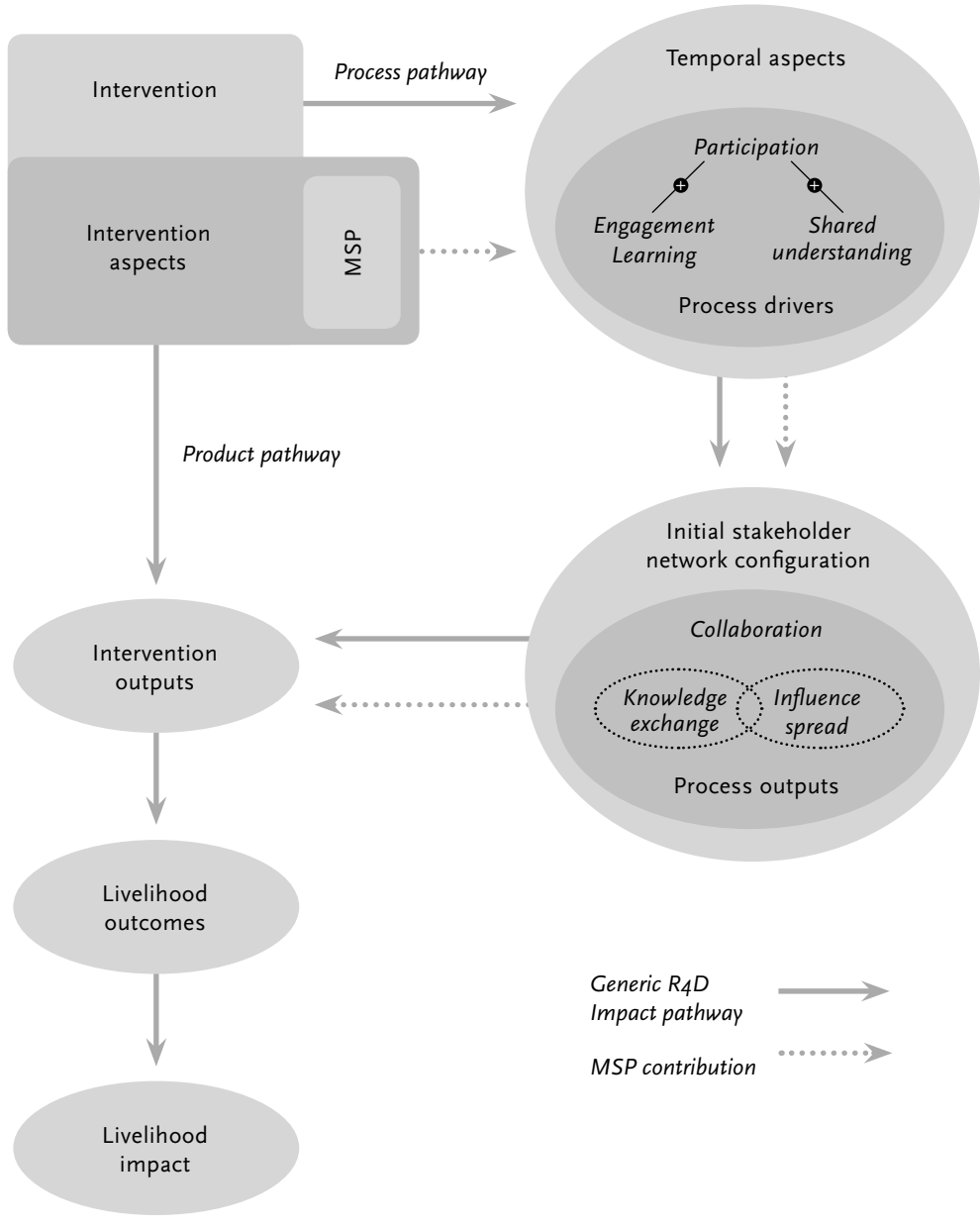
7.3.4 CONCLUSION 4

R4D interventions with MSPs lead to extension of existing configurations of process outputs

As the initial stakeholder network configuration tends to have a high influence (Conclusion 1) and factors that the intervention can control have a low influence on process outputs and their drivers (Conclusion 2), I argue that the network configurations related to different process outputs (i.e. collaboration, knowledge exchange, and so on) will extend mostly when interventions are organized through MSPs. The thesis provides much evidence regarding such an extension of the initial configuration. The MSPs studied were dominated by stakeholders operating at international and national scales as well as by NGOs in terms of number of organizations, and research organizations had central roles. Private sector stakeholders were hardly represented, and the coverage of MSPs in terms of influential stakeholders was not high (Figure 7-2, output characteristics). This initial configuration is an example of the typical knowledge exchange system in which CGIAR organizations operate (Leeuwis et al., 2018; CGIAR, 2012). In this system, CGIAR organizations tend to lead the interventions and support the knowledge exchange between national research systems and international and national NGOs. Although they encourage private sector stakeholders' involvement in the R4D process and attempt to connect influential actors, there is very limited actual involvement by the private sector (Poulton and Macartney, 2012; Rothenberger et al., 2005) and highly influential stakeholders (Larsen, 2011). In other words, in the cases studied, the R4D interventions and MSPs started as a knowledge exchange platform with limited influence spread and limited commercial exchange capacity.

Following the implementation of interventions with MSPs, the only positive changes in the process outputs related to knowledge exchange. Density and size of knowledge exchange networks increased in eight of the 10 MSPs studied (Chapter 4). Shared understanding and learning increased (Chapter 5). On the other hand, involvement of highly influential actors, who have a higher chance of being engaged with other high

Figure 7-3. Updated theory of change for studying MSPs in R4D intervention contexts.



influence actors, did not increase. Involvement of private sector stakeholders whose main interest lies in commercial exchange (i.e. accessing customers and inputs) in the MSPs did not increase (Chapter 4). Stakeholder participation and engagement were highly volatile and did not represent an increase (Chapter 5). In brief, interventions with MSPs led to strengthening knowledge exchange but did not contribute to influence spread or other processes such as commercial exchange. Therefore, I claim that R4D interventions with MSPs lead to extension of existing process configurations.

7. 4 Implications

In this section, I discuss the main implications of the results and conclusions of this thesis. The empirical results described in the thesis originated from MSP cases that met the following three conditions:

1. The intervention sites were located in low-income countries
2. The type of intervention is R4D as defined in Chapter 1, i.e. research plays a central role and aims to contribute to diverse livelihood outcomes, and diverse stakeholders participate in MSP decision making
3. The multi-stakeholder engagement modality is a platform, i.e. there are explicit mechanisms for research and non-research stakeholders to engage in the collective efforts of problem solving and decision making on a structured basis.

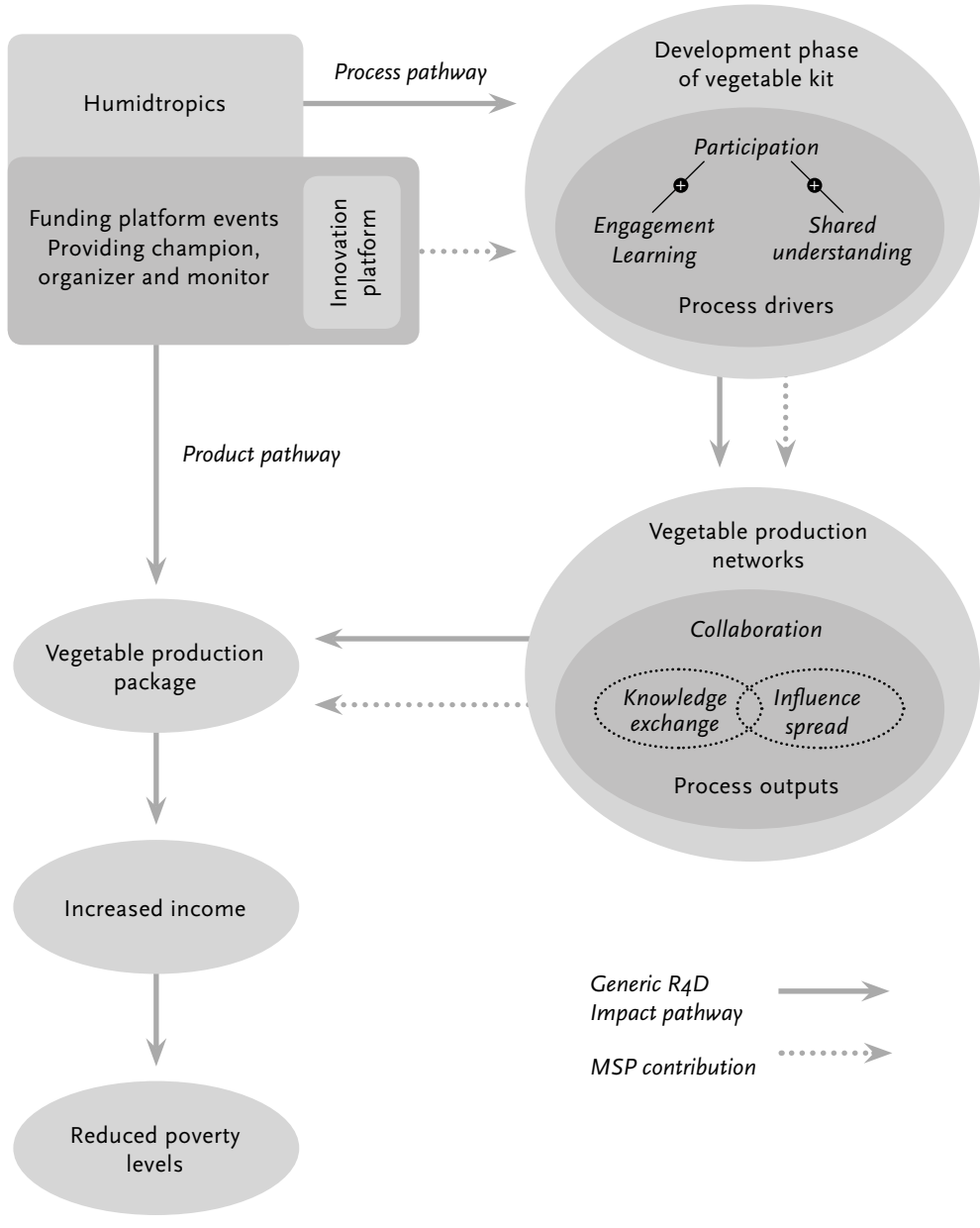
The implications of the thesis may be applicable to MSP cases beyond those satisfying these three conditions. However, extrapolation of the implications to such cases needs further validation studies. Below, I first discuss the implications for studying MSPs in the context of R4D interventions (section 7.4.1), followed by implications for the implementation of MSPs in the context of R4D interventions (section 7.4.2).

7.4.1 Implications for studying MSPs in the context of R4D interventions

Implication 1: The thesis proposes a theory of change that provides an important basis for advancing further research on how MSPs contribute to R4D interventions

The lack of a comprehensive framework that considers the dynamic aspects of MSP process outputs (collaboration, knowledge exchange, influence) and their drivers (participation, engagement, learning, shared understanding) was the first obstacle with which I had to deal in conducting the thesis research. As discussed in detail in Chapter 2, I developed a working generic theory of change based on a review of the MSP literature that presents the important interrelated outputs and outcomes, as well as assumptions about how these together influence the contribution of MSPs to R4D intervention performance (Figure 1-1).

Figure 7-4. Application of theory of change to examine an innovation platform in Humidtropics program for increasing adoption of a vegetable production package in Uganda.



Conclusions 1 to 4 provided further insights about the working theory of change. By using the conclusions and the thesis results, I have validated and updated the theory of change describing how MSPs contribute to the performance of R4D interventions (Figure 7-3). According to the new updated theory of change, two major intervention pathways trigger change in livelihood outcomes and impact. The first pathway is the product pathway in which an R4D intervention develops a product (e.g. a new variety or a new vaccine). In this pathway, MSPs are not necessary. Interventions can produce the outputs by using other participatory modalities where stakeholder involvement is not as structured, inclusive, or long term as in MSPs. Some examples for other participatory modalities are dissemination events, training sessions, or demonstrations or one-time consultation meetings where stakeholder influence is limited and not considered continuously throughout product design and testing. The second pathway is the process pathway where MSPs play a significant role. In the process pathway, interventions provide the main conditions such as financial and human resources for MSPs to contribute to enhanced participation, engagement, shared understanding, and learning (process drivers). The effects on the drivers are moderated by temporal aspects such as the R4D and innovation stages. The changes in the drivers influence collaboration, knowledge exchange, and influence (process outputs), depending on the initial MSP participant configuration. Finally, the process outputs influence the creation of intervention outputs.

To illustrate the use of the generic theory of change, I give the example of an innovation platform for increasing the adoption of vegetable production in Uganda (Figure 7-4). In one of the cases that I studied in Uganda, the Humidtropics program (intervention) aimed to reduce poverty (livelihood impact) by increasing farmers' income (livelihood outcome). It chose to adopt a vegetable production package (intervention output) and organized an innovation platform (MSP). It provided funding for the innovation platform events and hired a facilitator to enhance the interactions among stakeholders, innovation platform organizers to deal with logistics, and an innovation platform monitor to collect data and report back to the stakeholders (intervention aspects). Depending on the innovation development stage of the vegetable production package (i.e. is the vegetable production package an idea, or has it been tested and disseminated? – temporal aspects), the innovation platform contributed to an increase in shared understanding about various aspects of vegetable production (process driver) and enhanced learning about how to grow vegetables (process driver). Increased shared understanding and learning about growing vegetables contributed to an increase in knowledge exchange between researchers, development experts, and farmers (process output) on vegetable production and enhanced collaboration between these stakeholders (process output). Increased knowledge exchange and enhanced collaboration in turn led to better adoption of the vegetable production package (intervention output).

Table 7-3. Research questions and suggested research methods for studying contribution of MSPs to R4D interventions.

Component	Research questions	Current availability of research*	Suggested research methods
Intervention	What type of interventions?	Low	Principle component analysis
MSPs	What type of MSPs?	Low	Principle component analysis
Intervention aspects	Which R4D intervention resources influence MSPs' contribution to the performance?	Middle	Linear, Logit or Probit regressions
	Which R4D intervention principles, modalities influence the MSPs' contribution to process drivers?	Middle	Linear, Logit or Probit regressions
Temporal aspects	Which innovation and intervention stages influence MSPs' contribution?	High	Instrumental variable Regression (IVReg)
Process drivers	Which process drivers influence what process outputs?	Middle	Linear, Logit or Probit regressions
	How are different process drivers related to each other?	Low	Grounded theory
	What dynamic patterns do process drivers follow?	Very low	Non-linear pattern analysis (volatility)
	Which key process drivers can represent the overall contribution of MSPs to the R4D intervention performance?	High	Instrumental variable Regression (IVReg)
Initial stakeholder network configuration	Which network structures or characteristics influence the contribution?	Low	Social network analysis
Process outputs	Which process outputs influence the creation of intervention products?	Middle	Linear, Logit or Probit regressions
	What are the relationships between different process outputs?	Low	Analysis of Variance (ANOVA)
Intervention outputs	What are the differences between intervention outputs when interventions are organized with or without MSP?	Low	Grounded theory

* Current availability of research was identified by the review study conducted to support the thesis research.

The theory of change may be used as a reference framework for research on how MSPs contribute to interventions outputs, livelihood outcomes, and impacts. When developing the research proposal for the thesis, I intended to do a systematic review to synthesize the key learning on MSPs in the context of R4D. I could not do so because of the lack of a general theory of change that I could use to integrate findings from the different studies. It was particularly difficult to combine the findings and learning from studies that adopted quantitative and qualitative approaches. In the MSP and R4D literature, studies with quantitative approaches (e.g. Duflo et al., 2014; Pamuk et al., 2014) provided information about whether MSPs contributed and which livelihood outcomes and impact were generated. However, they did not provide enough insights into the mechanisms of how exactly MSPs contributed. On the other hand, studies using qualitative approaches (e.g. Anandajayasekeram, 2011; Ragin, 2014; Bryman, 2006) provided substantial information about such mechanisms but did not sufficiently report confounding factors.

Having a first generic theory of change on how MSPs contribute to R4D intervention performance is an important implication of this study. This generic theory of change provides a starting point for systematic review and further research on the overall learning and knowledge gaps on the relation between MSPs and R4D interventions. It allows for more indepth studies to explore additional process drivers and other types of process outputs and temporal factors and to validate their relations and outcomes in different geographical and socio-political contexts.

IMPLICATION 2

Mixed-method approaches and action research are required to foster comprehensive understanding of the contribution of MSPs to the performance of R4D interventions

The theory of change presented in Figure 7-3 includes 10 intervention aspects, of which eight were studied in the thesis. These eight components are different in their nature. Whereas some of them are tangible and have well-defined boundaries and concepts (e.g. intervention outputs), others are more abstract constructions (e.g. process drivers). In addition, the initial literature review that I conducted for the thesis research indicated that some of these components have been relatively frequently researched in the R4D context, but the number of studies on other components is very low. For instance, I did not find any studies dealing with the dynamic patterns of process drivers, such as participation and engagement. As a result, the research questions investigated in this thesis are different. Whereas some of the questions are 'which' questions that focus on existing potentially relevant factors such as existing intervention resources, i.e. funding, human resources, other questions are 'what' questions that focus on exploration and identifying relevant factors that influence the contribution of MSPs to intervention performance (Table 7-3). The type of data needed to answer these research questions ranges from quantitative data to measure the relative importance of and relation between different process drivers and process outputs, to qualitative data to understand their context and hard-to-measure relations. Such data were collected using a broad range of data collection methods, including surveys, interviews, participatory observations.

Action research was integral to the thesis research. First, the thesis required high frequency data collection and involved various stakeholders. It is easier to encourage stakeholders to be responsive if the collected data is useful for the stakeholders' own purposes, and action research increased the relevance of the collected data for the stakeholders. Second, the high flexibility intervention agenda required continuous adjustments in data collection practices, and action research guided the adjustments and decreased the time necessary for adjustment.

The difference in the nature of components, type of questions, availability of literature, and scope of data collection implies that comprehensive understanding of the contribution of MSPs to the performance of R4D interventions requires mixed-methods approaches and action research.

7.4.2 Implications for implementing MSPs in the context of R4D interventions

The thesis results and conclusions also have implications for the design and implementation of MSPs in the context of R4D interventions. The three major implications described in this section may be valuable for people and organizations such as R4D intervention developers, donors, and senior R4D managers who make strategic decisions about whether and how MSPs can contribute to achieving R4D outcomes.

IMPLICATION 3

The initial selection of MSP participants must be based on an assessment of the specific intervention or process outputs to which the MSP is supposed to contribute

MSP participants were selected initially mostly on the basis of existing collaborations and partnerships (Pali and Swaans, 2013; Van Mierlo et al., 2010). To justify that, it is often claimed that new stakeholders will join the MSP and that stakeholders will leave the MSP depending on the organic evolution of the MSP agenda (Dror et al., 2015; Lamers et al., 2017). However, from Conclusion 4, I claim that this approach is likely to constrain the contribution of the MSP to R4D interventions for three major reasons. Firstly, Conclusions 1 and 4 imply that building on existing collaborations will lead to a continuation of the ongoing innovation process and strengthen the incumbent systems and paradigms that caused problems in the first place. If achieving intervention outputs and livelihood outcomes requires complementary processes or alternative systems, then building on an existing stakeholder collaboration may not be the best

strategy. Secondly, collaboration involves multiple processes, such as knowledge exchange, exerting influence, or other process outputs (Figure 7-1, output characteristics). If MSP participants are initially selected without considering what specific intervention or process outputs are to be achieved, then the MSP configuration may not be able to deliver such outputs. Chapter 4 showed how MSPs can be excellent for knowledge exchange, but at the same time be very poor at exerting influence. If the success of an R4D intervention relies strongly on the presence of influential actors and their ability to exert their influence, then this MSP full of knowledge exchange champions will not be effective. Chapter 4 also indicated that there can be competition between the MSP and other stakeholder networks. Figure 4-4 shows that three different knowledge exchange clusters existed upon installation of the MSP. A later mapping of the same network showed that the MSP's knowledge exchange network had expanded, but that it had not been able to connect the two other competing knowledge exchange networks. This may imply that this MSP was effective in exchanging a specific type of knowledge (e.g. on organic vegetable production), but ineffective in exchanging other types of knowledge (e.g. on more conventional vegetable production). If the objective was to strengthen knowledge exchange between networks of organic and conventional vegetable producers, then the MSP failed. If the objective was to strengthen one network to outcompete the other network, then the MSP succeeded; this shows how an interpretation of MSP performance is objective based.

The implication for decision makers is to invest in mechanisms and tools that enable stronger linkages between (i) the desired intervention objectives (i.e. specific intervention or process outputs) and (ii) the initial configuration of MSP participants with the highest likelihood of achieving the R4D objectives during the later phases of the intervention. This thesis has shown that social network analysis can support making informed choices about the innovation and scaling potential in networks, and how to best embed MSPs in such networks.

IMPLICATION 4

Striving for equal stakeholder participation in MSPs may constrain R4D interventions in achieving objectives and outcomes

Prominent paradigms of R4D interventions aimed at livelihood improvements argue that increasing the representation and participation of all stakeholders in decision making and innovation processes will lead to sustainable solutions for livelihood problems (Roling and Wagemakers, 2000; Verhagen et al., 2008). This paradigm has a strong influence on the design and study of MSPs in the R4D context. Proponents of this paradigm argue that MSP failure is mostly the result of improper MSP implementation (Boogaard et al., 2013). I reject this argument by claiming that a well-performing MSP will not necessarily lead to more successful R4D interventions.

Implication 3 shows that the initial group of MSP participants influences to a large extent the ability of the MSP to achieve specific objectives and that there is a high likelihood of MSPs becoming arenas of struggle (Leeuwis, 2000) over the agenda and resources of the R4D intervention. For instance, Chapter 3 indicated that research actors were central and that private sector actors were hardly represented in any MSP networks studied in this thesis. In addition, it showed that none of the MSPs was well connected to influential actors. I argue that actors' willingness to actively invest in MSP participation depends on the benefits they expect to derive from the MSP (Lamers et al., 2017). The benefit accruing to research actors is central to R4D interventions and is based on generating public goods such as technologies and other types of innovation. The objective is to make these public goods available to as many potential beneficiaries as possible. The benefits for the private sector depend on scarcity in the availability of public goods that creates niches for companies and businesses to offer knowledge services, sell technologies, and maximize profits. Public and private benefits are not necessarily mutually exclusive, but there is a clear trade-off between MSP benefits for research and MSP benefits for the private sector that is not solved by a well-performing MSP.

Chapter 4 showed that innovation network size decreased in all the networks studied in this thesis and that actors' centrality in the network correlated with MSP participation over time, in the sense that actors with higher connectivity tended to participate longer in the MSP. In addition, the relative number of actors who participated in the knowledge exchange network increased in all the cases. Clusters of collaborating actors that were not connected to the organizations that led the R4D intervention, during the initiation of the MSPs, left the innovation network over time. In addition, Chapter 6 indicated that the innovations prioritized in different R4D stages, i.e. prioritization, horizontal, vertical, and system progress, as well as in different innovation stages, i.e. prioritization, generation, diffusion, and use of innovation, influence participation dynamics in the MSPs. These results imply that some prioritized MSP themes, R4D activities, and innovation stages are more attractive to some stakeholder groups, while at the same time being less attractive to other stakeholder groups. As R4D interventions are constrained in resources and time, there will always be forms of prioritization; this implies that not all stakeholders' needs and interests can be satisfied.

The implication for decision makers is twofold. First, strategic decision makers should consider whether the involvement of broader stakeholder groups is needed to achieve the R4D intervention objective. If the answer to this question is no, other stakeholder engagement modalities (such as direct bilateral engagement with specific stakeholder groups) should be explored. If the answer to this question is yes, then preliminary

analysis should be conducted to identify the specific stakeholder groups with an interest in the MSP theme and R4D activities and innovation stages to facilitate a focused and cost- and time-efficient MSP process. Alternatively, multiple MSPs with more limited mandates and stakeholder heterogeneity could be an option.

IMPLICATION 5

R4D interventions aiming at facilitating transformative change need to invest in complementary mechanisms beyond MSPs

The R4D literature commonly distinguishes between transformative and incremental innovations (Hermans et al., 2016; Du Plessis, 2007). It has been argued that some innovations support incremental changes that optimize the functioning of the innovation system over time, whereas other innovations cause or support transformative changes that lead to major changes in innovation systems or to new types of innovation systems (Hermans et al., 2016; Du Plessis, 2007). From the results in this thesis, I argue that the MSP approach is not conducive to R4D interventions aiming at supporting transformative change.

Transformative changes require the engagement and support of influential actors and organizations, and influence a broad range of stakeholders (Du Plessis, 2007; Weber and Rohracher, 2012). The thesis has shown that it is difficult to continuously engage stakeholders whose direct innovation needs and interests are not prioritized by the MSP. Chapters 3 and 4 showed that, notably, influential actors and organizations such as high-level policymakers or the private sector – paramount to support transformative change – were not involved in research-oriented MSPs. Examples exist where such actors have tried to hinder or question the legitimacy of the innovation process that will lead to the transformative change, as that change may carry risks or incur costs for them (Faysse, 2006; Warner, 2007). More generally speaking, consensus-based decision making by stakeholders with a broad range of needs and interests (in many ways the nature of what MSPs seek to achieve, see Implication 4) is unlikely to result in radical outcomes that can lead to transformative changes. Work by colleagues such as Warner (2007) reached similar conclusions.

R4D interventions that are required or aim to support transformative changes need to go beyond MSPs as their main approach. MSPs can fulfill a role in designing and testing specific types of technological, organizational, or institutional innovations in a controlled setting. For real transformation to take place, other stakeholder engagement strategies such as high-level policy dialogues or presentations to donor councils may be needed to ensure that transformative innovations become embedded in new policy or business or development strategies where they can lead to broad-based changes.

The implication for decision makers is that MSPs can be part of an R4D intervention strategy in which other stakeholder engagement approaches are also used to fulfill other, complementary functions and roles.

7.4.3 From implications to MSP feasibility assessment (ex-ante) and reflexive monitoring (ex-durante)

As mentioned in section 7.4.1, an important result of this study is a first generic theory of change on how MSPs contribute to R4D interventions. Having such a theory of change is important for further research (as stated under Implication 1) but can also form the basis for ex-ante assessment of MSP feasibility and for MSP monitoring.

In terms of MSP feasibility assessment, the MSP theory of change supports more effective and realistic assessment of how MSPs can contribute to R4D interventions. By clearly stating the importance of product and process outputs, it can support actors that develop and fund R4D interventions in critically assessing whether the available intervention resources are likely to result in the desired product and process outputs, given the (temporal) context in which the MSP is embedded.

The results generated during the thesis research, the conclusions, and the implications presented in this chapter can be used to create a simple tool for assessing the potential contribution of MSPs to R4D intervention performance. As the results used in the thesis are generated by LESARD, these tools can be added to the LESARD toolset to enhance its capabilities as a more reflexive selfassessment system and contribute to the recent tool development efforts (Schut et al., 2018) for increasing the effectiveness and the efficiency of MSPs. Questions that can guide decision making include:

- Does achieving the R4D intervention objective require substantial involvement of private sector stakeholders?
- Does achieving the R4D intervention objective require substantial involvement of highly influential stakeholders?
- Does the R4D intervention objective require, or aim for, transformative change?
- Does the R4D intervention objective require the engagement of a large network of diverse stakeholders?
- Is there any uncertainty about the allocation of sufficient resources (human, time, finance) to support the development of both product and process?
- Does the R4D intervention require continuous high engagement by different stakeholder groups?

If any of the answers is yes, then using an MSP approach is hardly feasible for R4D interventions operationalized in a low-income country context.

In terms of supporting reflexive MSP monitoring, the theory of change facilitates

assessing anticipated against real changes in process drivers, process outputs, and intervention outputs. Consequent to the monitoring, the theory of change can be reviewed and updated, and the MSP approach, facilitation, or composition can be adjusted in a timely fashion and during the process. Questions that can guide reflexive monitoring include:

- Is participation in the R4D intervention events compatible with the intervention objectives?
- Is shared understanding and stakeholder engagement increasing?
- Do the MSP participants increase their knowledge on the innovation's R4D intervention target?
- Is the proportion of stakeholders needed to achieve the R4D intervention objective increasing in the collaboration network?
- Is the knowledge exchange network becoming larger or denser?
- Can the MSP participants access influential stakeholders in the areas in which the intervention operates?

If the responses given to the above questions are affirmative, then the MSP is likely to make an important contribution to achieving the R4D intervention objectives. If the answers are not affirmative, then the MSP facilitators and R4D management should explore making changes in the way the MSP is operating or decide to replace or complement the MSP with other stakeholder engagement approaches, as discussed in section 7.4.2 (Implication 4).

The above sets of questions could lead to the further development of additional LESARD tools for MSP feasibility assessment (ex-ante) and reflexive monitoring (ex-durante). Such tools should be user-friendly, provide direct feedback to MSP organizers and participants, and be applicable to different types of MSPs in different types of sectors.

7.5 Final reflection: Do multi-stakeholder platforms work?

Do multi-stakeholder platforms work? was the core question that made me curious enough to start the thesis research approximately four years ago. At that time, there were substantial investments in MSPs, and they were considered a tool that would transform the dynamics of R4D interventions. I was very excited to work on MSPs, hoping that I would contribute to the development of this supposedly transformative tool! However, soon after 10 MSPs were initiated in four countries in East and Central Africa, and soon after I became partially involved in studying other MSPs not reported in this thesis, my excitement started to diminish. From the early stages of the research onwards, I encountered major performance issues regarding MSPs that would hinder them in fostering transformative change. At the same time, I observed many stakeholders with different backgrounds being passionate about implementing MSPs, as well as a further proliferation of their use in R4D practice. After three years of empirical research including many direct observations on the ground, I argue that expectations regarding the contribution of MSPs to R4D intervention performance have been overstated. This thesis research has clearly shown that MSPs can improve some process drivers (i.e. shared understanding and learning) and can trigger positive changes in knowledge exchange. However, it also concludes that MSPs do not have a major impact on participation and engagement and do not lead to increased collaboration or influence spread. At the same time, the achievement of the kinds of livelihood outcomes and livelihood impacts to which R4D interventions typically aspire is unlikely to materialize without the broad participation and engagement of highly influential actors in the private and the public sector. Hence, the dynamics in and around the MSPs studied were incompatible with the transformative objectives of the R4D interventions. This means that MSPs can play a meaningful role in R4D interventions, but we need to be modest and realistic about what they can and cannot achieve. Moreover, it is likely that MSPs need to be complemented with other intervention strategies and stakeholder engagement approaches.

References

Aaltonen, K., and Kujala, J. (2010). A project lifecycle perspective on stakeholder influence strategies in global projects. Scandinavian Journal of Management, 26(4):381–397.

Abate, T., Shiferaw, B., Gebeyehu, S., Amsalu, B., Negash, K., Assefa, K., Eshete, M., Aliye, S., and Hagmann, J. (2011). A systems and partnership approach to agricultural research for development: Lessons from Ethiopia. Outlook on Agriculture, 40(3):213–220.

Abbott, K.W. (2012). Engaging the public and the private in global sustainability governance. International Affairs, 88(3):543–564.

Adekunle, A., and Fatunbi, A. (2012). Approaches for setting-up multi-stakeholder platforms for agricultural research and development. World Applied Sciences Journal, 16(7):981–988.

Agarwal, B. (2001). Participatory exclusions, community forestry, and gender: An analysis for south Asia and a conceptual framework. World Development, 29(10):1623–1648.

Aguilar-Gallegos, N., Munoz-Rodriguez, M., Santoyo-Cortes, H., Aguilaravila, J., and Klerkx, L. (2015). Information networks that generate economic value: A study on clusters of adopters of new or improved technologies and practices among oil palm growers in Mexico. Agricultural Systems, 135:122–132.

Aker, J. C., Ghosh, I., and Burrell, J. (2016). The promise (and pitfalls) of ICT for agriculture initiatives. Agricultural Economics, 47(S1):35–48.

Akhtar-Schuster, M., Thomas, R. J., Stringer, L. C., Chasek, P., and Seely, M. (2011). Improving the enabling environment to combat land degradation: Institutional, financial, legal and science policy challenges and solutions. Land Degradation & Development, 22(2):299–312.

Akpo, E., Crane, T.A., Vissoh, P.V., and Tossou, R.C. (2014). Co-production of knowledge in multi-stakeholder processes: Analyzing joint experimentation as social learning. Journal of Agricultural Education and Extension, 21(4):369–388.

Alsop, R., and Farrington, J. (1998). Nests, nodes and niches: A system for process monitoring, information exchange and decision making for multiple stakeholders. World Development, 26(2):249–260.

Amerasinghe, P., Cofie, O., and Drechsel, P. (2013). Facilitating outcomes: Multi-stakeholder processes for influencing policy change on urban agriculture in selected west African and south Asian cities. Report 9290907770, IWMI.

Anandajayasekeram, P. (2011). The role of agricultural R&D within the agricultural innovation systems framework. In Report Prepared for the ASTI/IFPRI-FARA Conference.

Ashby, J. (2003). Introduction: Uniting science and participation in the process of

innovation: Research for development. In Managing Natural Resources for Sustainable Livelihoods: Uniting science and participation. Earthscan.
Assaye, A., Melak, A., Ayalew, B., Teshale, D., and Mazengia, Y. (2015). Assessment of seed systems in North Western Ethiopia; with special emphasis on community based seed multiplication scheme. World Scientific News, 12:100–110.
Avelino, F., and Rotmans, J. (2009). Power in transition: An interdisciplinary framework to study power in relation to structural change. European Journal of Social Theory, 12(4):543–569.
Aw-Hassan, A.A. (2008). Strategies for outscaling participatory research approaches for sustaining agricultural research impacts. Development in Practice, 18(4–5):564–575.
Backstrand, K. (2006). Multi-stakeholder partnerships for sustainable development: Rethinking legitimacy, accountability and effectiveness. Environmental Policy and Governance, 16(5):290–306.
Badibanga, T., Ragasa, C., and Ulimwengu, J. (2013). Assessing the effectiveness of multi-stakeholder platforms: Agricultural and rural management councils in the Democratic Republic of the Congo, volume 1258. Intl Food Policy Res Inst. https://pdfs.semanticscholar.org/974d/247b1cd2ee4b297987fad5ea8d551dc729b2.pdf
Baeckstrand, K. (2006). Multi-stakeholder partnerships for sustainable development: Rethinking legitimacy, accountability and effectiveness. European Environment, 16(5):290–306.
Balan, V., Chiaramonti, D., and Kumar, S. (2013). Review of US and EU initiatives toward development, demonstration, and commercialization of lignocellulo-sic biofuels. Biofuels, Bioproducts and Biorefining, 7(6):732–759.
Barlow, J., Bayer, S., and Curry, R. (2006). Implementing complex innovations in fluid multi-stakeholder environments: Experiences of 'telecare'. Technovation, 26(3):396–406.
Barrientos, S., Dolan, C., and Tallontire, A. (2003). A gendered value chain approach to codes of conduct in African horticulture. World Development, 31(9):1511–1526.
Basiron, Y. (2007). Palm oil production through sustainable plantations. European Journal of Lipid Science and Technology, 109(4):289–295.
Bastian, M., Heymann, S., and Jacomy, M. (2009). Gephi: An open source software for exploring and manipulating networks. ICWSM, 8:361–362.
Bawden, R. J. (1992). Systems approaches to agricultural development: The Hawkesbury experience. Agricultural Systems, 40(1-3):153–176.
Beall, J., and Todes, A. (2004). Gender and integrated area development projects: Lessons from Cato Manor, Durban. Cities, 21(4):301–310.
Bebbington, A., and Farrington, J. (1993). Governments, NGOs and agricultural development: Perspectives on changing inter-organizational relationships. The Journal of Development Studies, 29(2):199–219.

Beers, P.J., and Geerling-Eiff, F. (2014). Networks as policy instruments for innovation. The Journal of Agricultural Education and Extension, 20(4):363–379.
Beers, P.J., Hermans, F., Veldkamp, T., and Hinssen, J. (2014). Social learning inside and outside transition projects: Playing free jazz for a heavy metal audience. NJAS-Wageningen Journal of Life Sciences, 69:5–13.
Bendell, J. (2005). In whose name? The accountability of corporate social responsibility. Development in Practice, 15(3–4):362–374.
Berti, P.R., Krasevec, J., and FitzGerald, S. (2004). A review of the effectiveness of agriculture interventions in improving nutrition outcomes. Public Health Nutrition, 7(5):599–609.
Biermann, F., Mansan, C., Aysem, M., and Pattberg, P. (2007). Multi-stakeholder partnerships for sustainable development: Does the promise hold? Report 1847208665. https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=1744&menu=1515
Blignault, I., Haswell, M.R., and Pulver, L.J. (2015). The value of partnerships: Lessons from a multisite evaluation of a national social and emotional wellbeing program for indigenous youth. Australian and New Zealand Journal of Public Health. https://doi.org/10.1111/1753-6405.12403
Bloom, Paul and Skloot, E. (2010). Scaling Social Impact: New thinking. Springer.
Boogaard, B.K., Schut, M., Klerkx, L., Leeuwis, C., Duncan, A., and Cullen, B. (2013). Critical issues for reflection when designing and implementing research for development in innovation platforms. Wageningen UR, Knowledge, Technology & Innovation Group.
Borgatti, S.P. (2006). Identifying sets of key players in a social network. Computational & Mathematical Organization Theory, 12(1):21–34.
Bosch, O., King, C., Herbohn, J. L., Russell, I., and Smith, C. (2007). Getting the big picture in natural resource management systems thinking as a method for scientists, policy makers and other stakeholders. Systems Research and Behavioral Science, 24(2):217–232.
Bosher, L., Dainty, A., Carrillo, P., Glass, J., and Price, A. (2009). Attaining improved resilience to floods: A proactive multi-stakeholder approach. Disaster Prevention and Management: An International Journal, 18(1):9–22.
Braga, F. (2015). The sustainable agriculture initiative platform: The first 10 years. Journal on Chain and Network Science, 15(1):27–38.
Brooks, J., Waylen, K.A., and Mulder, M.B. (2013). Assessing community-based conservation projects: A systematic review and multilevel analysis of attitudinal, behavioral, ecological, and economic outcomes. Environmental Evidence, 2(2). https://doi.org/10.1186/2047-2382-2-2
Bryman, A. (2006). Integrating quantitative and qualitative research: How is it done? Qualitative Research, 6(1):97–113.

Buckland-Merrett, G.L., Kilkenny, C., and Reed, T. (2017). Civil society engagement in multi-stakeholder dialogue: A qualitative study exploring the opinions and perceptions of meta members. Journal of Pharmaceutical Policy and Practice, 10(1):5. https://doi.org/10.1186/s40545-016-0096-0

Bizikova, L., Nijnik, M., and Kluvanková-Oravská, T. (2012). Sustaining multifunctional forestry through the developing of social capital and promoting participation: A case of multiethnic mountain communities. Small-Scale Forestry, 11(3):301–319.

Cash, D., Adger, W.N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L., and Young, O. (2006). Scale and cross-scale dynamics: Governance and information in a multilevel world. Ecology and Society, 11(2). https://www-jstor-org.ezproxy.library.wur.nl/stable/pdf/26265993.pdf

CGIAR (2012). CRP 1.2: Proposal for integrated systems for humid tropics research program. Report, The Consultative Group on International Agricultural Research. https://cgspace.cgiar.org/handle/10568/35409

Chambers, R. (1994). The origins and practice of participatory rural appraisal. World Development, 22(7):953–969.

Clark, T. (2008). We're over-researched here!' Exploring accounts of research fatigue within qualitative research engagements. Sociology, 42(5):953–970.

Comby, E., Le Lay, Y., and Piegay, H. (2014). The achievement of a decentralized water management through stakeholder participation: An example from the Drome River catchment area in France (1981–2008). Environmental Management, 54(5):1074–1089.

Connell, J.P., (1995). New approaches to evaluating community initiatives: Concepts, methods, and contexts. Aspen Institute. Publications Office, PO Box 222, 109 Houghton Lab Lane, Queenstown, MD 21658

Cook, W.K. (2008). Integrating research and action: A systematic review of community-based participatory research to address health disparities in environmental and occupational health in the USA. Journal of Epidemiology and Community Health, 62(8):668–676.

Curry, L., Taylor, L., Pallas, S.W., Cherlin, E., Perez-Escamilla, R., and Bradley, E.H. (2013). Scaling up depot medroxyprogesterone acetate (DMPA): A systematic literature review illustrating the aided model. Reproductive Health, 10(1), 39. DOI: 10.1186/1742-4755-10-39

Davis, J., and Whittington, D. (1998). Participatory research for development projects: A comparison of the community meeting and household survey techniques. Economic Development and Cultural Change, 47(1):73–94.

De Nooy, W., Mrvar, A., and Batagelj, V. (2011). Exploratory Social Network Analysis with Pajek, volume 27. Cambridge University Press.

Delisle, H., Roberts, J.H., Munro, M., Jones, L., and Gyorkos, T.W. (2005). The role of NGOs in global health research for development. Health Research Policy and Systems, 3(1),3. DOI: 10.1186/1478-4505-3-3

den Exter, R., Lenhart, J., and Kern, K. R. (2015). Governing climate change in Dutch cities: Anchoring local climate strategies in organization, policy and practical implementation. Local Environment, 20(9):1062–1080.

Derak, M., Taiquib, L., Aledoc, A., and Cortina, J. (2016). Similarities in stakeholder identification of restoration targets in a semiarid area. Journal of Arid Environments, 128:30–39.

Devaux, A., Horton, D., Velasco, C., Thiele, G., Lopez, G., Bernet, T., Reinoso, I., and Ordinola, M. (2009). Collective action for market chain innovation in the Andes. Food Policy, 34(1):31–38.

deZeeuw, H. (2010). Cities farming for the future – Multi-stakeholder policy formulation and action planning on urban agriculture in developing countries. Acta Horticulturae, (881):97–109.

Dhand, A., Luke, D.A., Carothers, B.J., and Evanoff, B.A. (2016). Academic cross-pollination: The role of disciplinary affiliation in research collaboration. PLoS One, 11(1):e0145916.

Dickson-Gomez, J., Corbett, A.M., Bodnar, G., Zuniga, M.O., Guevara, C.E., Rodriguez, K., and Navas, V. (2016). Context and group dynamics in a CBPR-developed HIV prevention intervention. Health Promotion International, 31(1):93–105.

Djalante, R. (2012). Adaptive governance and resilience: The role of multi-stakeholder platforms in disaster risk reduction. Natural Hazards & Earth System Sciences, 12(9). DOI: 10.5194/nhess-12-2923-2012

Douthwaite, B., Kuby, T., van de Fliert, E., and Schulz, S. (2003). Impact pathway evaluation: An approach for achieving and attributing impact in complex systems. Agricultural Systems, 78(2):243–265.

Dror, I., Cadilhon, J.J., Schut, M., Misiko, M., and Maheshwari, S. (2015). Innovation Platforms for Agricultural Development: Evaluating the mature innovation platforms landscape. Routledge.

Du Plessis, M. (2007). The role of knowledge management in innovation. Journal of Knowledge Management, 11(4):20–29.

Du Toit, D., and Pollard, S. (2008). Updating public participation in IWRM: A proposal for a focused and structured engagement with catchment management strategies. Water SA, 34(6):707–713.

Duflo, E., Keniston, D., and Suri, T. (2014). Diffusion of technologies within social networks: Evidence from a coffee training program in Rwanda. https://www.theigc.org/project/diffusion-of-technologies-within-social-networks-evidence-from-a-coffee-training-program-in-rwanda/

Eggersdorfer, M., and Bird, J.K. (2016). How to Achieve Transparency in Public–Private Partnerships Engaged in Hunger and Malnutrition Reduction, volume 115, pages 224–232. Karger Publishers.

Eng, A.G. (2012). 2011 biomass program platform peer review. sustainability. Report, Office of Energy Efficiency and Renewable Energy (EERE), Washington, DC (United States).

Eriksson, C.C.G., Fredriksson, I., Fraeding, K., Geidne, S., and Pettersson, C. (2014). Academic practice–policy partnerships for health promotion research: Experiences from three research programs. Scandinavian Journal of Public Health, 42(15 suppl):88–95.

Esparcia, J. (2014). Innovation and networks in rural areas: An analysis from European innovative projects. Journal of Rural Studies, 34:1–14.

Failing, L., Horn, G., and Higgins, P. (2004). Using expert judgment and stakeholder values to evaluate adaptive management options. Ecology and Society, 9(1). DOI: 10.5751/ES-00643-090113

Faysse, N. (2006). Troubles on the way: An analysis of the challenges faced by multi stakeholder platforms. Natural Resources Forum, 30(3):219–229.

Fazey, I., Bunse, L., Msika, J., Pinke, M., Preedy, K., Evely, A. C., Lambert, E., Hastings, E., Morris, S., and Reed, M.S. (2014). Evaluating knowledge exchange in interdisciplinary and multi-stakeholder research. Global Environmental Change, 25:204–220.

Ferroni, M., and Castle, P. (2011). Public–private partnerships and sustainable agricultural development. Sustainability, 3(7):1064–1073.

Fleury, P., Petit, S., Dobremez, L., Schermer, M., Kirchengast, C., De Ros, G., Magnani, N., Struffi, L., Mieville-Ott, V., and Roque, O. (2008). Implementing sustainable agriculture and rural development in the European alps: Assets and limitations of local project based on multi-stakeholder participation. Mountain Research and Development, 28(3-4):226–232.

Fliervoet, J.M., van den Born, R.J.G., and Meijerink, S.V. (2017). A stakeholder's evaluation of collaborative processes for maintaining multi-functional flood-plains: A Dutch case study. International Journal of River Basin Management, 15(2):175–186.

Foran, T., Butler, J.R.A., Williams, L.J., Wanjura, W.J., Hall, A., Carter, L., and Carberry, P. S. (2014). Taking complexity in food systems seriously: An interdisciplinary analysis. World Development, 61:85–101.

Franzel, S., Denning, G.L., Lillesø, J.P.B., and Mercado Jr, A.R. (2004). Scaling up the impact of agroforestry: Lessons from three sites in Africa and Asia. Agroforestry Systems, 61–62(1–3):329–344.

Giller, K.E., Leeuwis, C., Andersson, J., Andriesse, W., Brouwer, A.M., Frost, P., Hebinck, P., Heitknig, I., van Ittersum, M., and Koning, N.B.J. (2008). Competing claims on natural resources: What role for science? Ecology and Society, 13(2). http://www.ecologyandsociety.org/vol13/iss2/art34/

Giuliani, E. (2013). Network dynamics in regional clusters: Evidence from Chile. Research Policy, 42(8):1406–1419.

Goodreau, S.M. (2007). Advances in exponential random graph (p*) models applied to a large social network. Social Networks, 29(2):231–248.

Greenhalgh, T., and Fahy, N. (2015). Research impact in the community-based health sciences: An analysis of 162 case studies from the 2014 UK research excellence framework. BMC Medicine, 13(1):232. DOI: 10.1186/s12916-015-0467-4

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., and Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. Milbank Quarterly, 82(4):581–629.

Gupta, S. (2014). Worlds apart? Challenges of multi-agency partnership in participatory watershed development in Rajasthan, India. Development Studies Research. An Open Access Journal, 1(1):100–112.

Haemaelaeinen, R., Kettunen, E., Marttunen, M., and Ehtamo, H. (2001). Evaluating a framework for multi-stakeholder decision support in water resources management. Group Decision and Negotiation, 10(4):331–353.

Hale, T.N., and Mauzerall, D.L. (2004). Thinking globally and acting locally: Can the Johannesburg partnerships coordinate action on sustainable development? The Journal of Environment & Development, 13(3):220–239.

Hall, A. (2006). Public private sector partnerships in an agricultural system of innovation: Concepts and challenges. International Journal of Technology Management & Sustainable Development, 5(1):3–20.

Hall, A., Bockett, G., Taylor, S., Sivamohan, M., and Clark, N. (2001). Why research partnerships really matter: Innovation theory, institutional arrangements and implications for developing new technology for the poor. World Development, 29(5):783–797.

Hall, A. and Clark, N. (2010). What do complex adaptive systems look like and what are the implications for innovation policy? Journal of International Development, 22(3):308–324.

Hall, A., Clark, N., Sulaiman, R., Sivamohan, M.V.K., and Yoganand, B. (2000). New agendas for agricultural research in developing countries: Policy Analysis and Institutional Implications. Knowledge, Technology & Policy, 13(1):70–91.

Hall, A., Sulaiman, V.R., Clarke, N., and Yoganand, B. (2003). From measuring impact to learning institutional lessons: An innovation systems perspective on improving the management of international agricultural research. Agricultural Systems, 78(2):213–241.

Handcock, M.S., Hunter, D.R., Butts, C.T., Goodreau, S.M., and Morris, M. (2008). statnet: Software tools for the representation, visualization, analysis and simulation of network data. Journal of Statistical Software, 24(1):1548. Doi?

Harris, J.K. (2013). An Introduction to Exponential Random Graph Modeling, Volume 173 in Series : Quantitative Applications in the Social Sciences. Sage Publications.

Harris, J.K., Carothers, B.J., Wald, L.M., Shelton, S.C., and Leischow, S.J. (2012). Inter-

personal influence among public health leaders in the United States Department of Health and Human Services. Journal of Public Health Research, 1(1):67. DOI: 10.4081/jphr.2012.e12

Head, B.W. (2008). Assessing network-based collaborations: Effectiveness for whom? Public Management Review, 10(6):733–749.

Hekkert, M.P., Suurs, R.A., Negro, S.O., Kuhlmann, S., and Smits, R.E. (2007). Functions of innovation systems: A new approach for analysing technological change. Technological Forecasting and Social Change, 74(4):413–432.

Hemmati, M. (2002). Multi-Stakeholder Processes for Governance and Sustainability: Beyond deadlock and conflict. Routledge, New York.

Hermans, F., Haarmann, W.M.F., and Dagevos, J.F.L.M.M. (2011). Evaluation of stakeholder participation in monitoring regional sustainable development. Regional Environmental Change, 11(4):805–815.

Hermans, F., Klerkx, L., and Roep, D. (2015). Structural conditions for collaboration and learning in innovation networks: Using an innovation system performance lens to analyze agricultural knowledge systems. The Journal of Agricultural Education and Extension, 21(1):35–54.

Hermans, F., Roep, D., and Klerkx, L. (2016). Scale dynamics of grassroots innovations through parallel pathways of transformative change. Ecological Economics, 130:285–295.

Hermans, F., Sartas, M., van Schagen, B., van Asten, P., and Schut, M. (2017). Social network analysis of multi-stakeholder platforms in agricultural research for development: Opportunities and constraints for innovation and scaling. PloS one, 12(2), e0169634.

Hermans, F., Stuiver, M., Beers, P.J., and Kok, K. (2013). The distribution of roles and functions for upscaling and outscaling innovations in agricultural innovation systems. Agricultural Systems, 115:117–128.

Holman, N. (2008). Community participation: Using social network analysis to improve developmental benefits. Environment and Planning C: Government and Policy, 26(3):525–543.

Homann-Kee Tui, S., Adekunle, A., Lundy, M., Tucker, J., Birachi, E.A., Schut, M., Klerkx, L., Ballantyne, P., Duncan, A., Cadilhon, J.J., et al. (2013). What Are Innovation Platforms? Technical report, CGIAR.

Home, R., and Rump, N. (2015). Evaluation of a multi-case participatory action research project: The case of SOLINSA. Journal of Agricultural Education and Extension, 21(1):73–89.

Huang, X., Faysse, N., and Ren, X. (2017). A multi-stakeholder platform involving a mining company and neighboring villages in china: Back to development issues. Resources Policy, 51:243–250.

Huibers, F., Redwood, M., and Raschid-Sally, L. (2010). Challenging conventional approaches to managing wastewater use in agriculture. Wastewater Irrigation and Health: Assessing and Mitigating Risk in Low-income Countries, pp. 287–301.

Hunter, D.R., Goodreau, S.M., and Handcock, M.S. (2008). Goodness of fit of social network models. Journal of the American Statistical Association, 103(481):248–258.

Isaac, M.E. (2012). Agricultural information exchange and organizational ties: The effect of network topology on managing agrodiversity. Agricultural Systems, 109:9–15.

Johnson, N.L., Lilja, N., and Ashby, J.A. (2003). Measuring the impact of user participation in agricultural and natural resource management research. Agricultural Systems, 78(2):287–306.

Joy, K.J., Paranjape, S., and Kulkarni, S. (2008). Multi-stakeholder Participation, Collaborative Policy Making and Water Governance: The Need for a Normative Framework, pages 269–285. SAGE Publications, India.

Kaaria, S., Lilja, N., Sandoval, V., Garcia, J.A., Hincapia, F., and Sanchez, F. (2005). Assessing impacts of farmer participatory research approaches: A case study of local agricultural research committees in Colombia (CIALs). CIAT Colombia.

Kachel, U., and Jennings, G. (2010). Exploring tourists' environmental learning, values and travel experiences in relation to climate change: A postmodern constructivist research agenda. Tourism and Hospitality Research, 10(2):130–140.

Kaiser, D.B., Koehler, T., and Weith, T. (2016). Knowledge management in sustainability research projects: Concepts, effective models, and examples in a multi-stakeholder environment. Applied Environmental Education & Communication, 15(1):4–17.

Kasonde, J.M., and Campbell, S. (2012). Creating a knowledge translation platform: Nine lessons from the Zambia forum for health research. Health Research Policy and Systems, 10(1):31. DOI: 10.1186/1478-4505-10-31

Kefasi, N., Oluwole, F., Adewale, A., and Gbadebo, O. (2011). Promoting effective multi-stakeholder partnership for policy development for smallholder farming systems: A case of the sub-Saharan Africa challenge programme. African Journal of Agricultural Research, 6(15):3451–3455.

Kemp, R., Schot, J., and Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. Technology Analysis & Strategic Management, 10(2):175–198.

Kilelu, C.W., Klerkx, L., and Leeuwis, C. (2013). Unravelling the role of innovation platforms in supporting co-evolution of innovation: Contributions and tensions in a smallholder dairy development programme. Agricultural Systems, 118:65–77.

Kilian, B., Zooiga, R., and Murillo, J.V. (2013). Decision processes in introducing hybrid agricultural plants: Ecom coffee group case study. Informing Science: The International Journal of an Emerging Transdiscipline, 16:213–229.

King, E., Samii, C., and Snilstveit, B. (2010). Interventions to promote social cohesion in sub-Saharan Africa. Journal of Development Effectiveness, 2(3):336–370.

Klenk, N.Z., and Wyatt, S. (2015). The design and management of multi-stakeholder research networks to maximize knowledge mobilization and innovation opportunities in the forest sector. Forest Policy and Economics, 61:77–86.

Klerkx, L., Adjei-Nsiah, S., Adu-Acheampong, R., Saidou, A., Zannou, E., Soumano, L., Sakyi-Dawson, O., van Paassen, A., and Nederlof, S. (2013). Looking at agricultural innovation platforms through an innovation champion lens: An analysis of three cases in West Africa. Outlook on Agriculture, 42(3):185–192.

Klerkx, L., Van Mierlo, B., and Leeuwis, C. (2012). Evolution of systems approaches to agricultural innovation: Concepts, analysis and interventions, pages 457–483. Springer, Dordrecht, the Netherlands. DOI: 10.1007/978-94-007-4503-2_20

Kongo, V.M., Kosgei, J.R., Jewitt, G.P.W., and Lorentz, S.A. (2010). Establishment of a catchment monitoring network through a participatory approach in a rural community in South Africa. Hydrology and Earth System Sciences, 14(12):2507–2525.

Kozica, S.L., Lombard, C.B., Harrison, C.L., and Teede, H.J. (2016). Evaluation of a large healthy lifestyle program: Informing program implementation and scale-up in the prevention of obesity. Implementation Science, 11(1):151. DOI: 10.1186/s13012-016-0521-4

Krishna, V.V., and Qaim, M. (2007). Estimating the adoption of BT eggplant in India: Who benefits from public–private partnership? Food Policy, 32(5):523–543.

Krivitsky, P.N. (2012). Exponential-family random graph models for valued networks. Electronic Journal of Statistics, 6:1100. DOI: 10.1214/12-EJS696

Krivitsky, P. N. and Morris, M. (2017). Inference for social network models from egocentrically sampled data, with application to understanding persistent racial disparities in HIV prevalence in the us. The annals of applied statistics, 11(1):427.

Lamb, J.N., Moore, K.M., Norton, J., Omondi, E.C., Laker-Ojok, R., Sikuku, D.N., Ashilenje, D.S., and Odera, J. (2016). A social networks approach for strengthening participation in technology innovation: Lessons learnt from the Mount Elgon region of Kenya and Uganda. International Journal of Agricultural Sustainability, 14(1):65–81.

Lambrecht, I., Vanlauwe, B., Merckx, R., and Maertens, M. (2014). Understanding the process of agricultural technology adoption: Mineral fertilizer in eastern DR Congo. World Development, 59:132–146.

Lamers, D., Schut, M., Klerkx, L., and van Asten, P. (2017). Compositional dynamics of multi-level innovation platforms in agricultural research for development. Science and Public Policy, 44(6), 739–752.

Lamprinopoulou, C., Renwick, A., Klerkx, L., Hermans, F., and Roep, D. (2014). Application of an integrated systemic framework for analysing agricultural innovation systems and informing innovation policies: Comparing the Dutch and Scottish agri-food sectors. Agricultural Systems, 129:40–54.

Larmarange, J., Mossong, J., Barnighausen, T., and Newell, M.L. (2015). Participation dynamics in population-based longitudinal HIV surveillance in rural south Africa. PloS One, 10(4):e0123345.

Larsen, G.D. (2011). Understanding the early stages of the innovation diffusion process: Awareness, influence and communication networks. Construction Management and Economics, 29(10):987–1002.

Laws, S., Harper, C., Jones, N., and Marcus, R. (2013). Research for Development: A practical guide. Sage.

Lebel, L., Grothmann, T., and Siebenhuner, B. (2010). The role of social learning in adaptiveness: Insights from water management. International Environmental Agreements: Politics, Law and Economics, 10:333–353.

Leeuwis, C. (2000). Reconceptualizing participation for sustainable rural development: Towards a negotiation approach. Development and Change, 31(5):931–959.

Leeuwis, C., Klerkx, L., Schut, M. (2018). Reforming the research policy and impact culture in the CGIAR: Integrating science and systemic capacity development. Global Food Security, 16:17-21, https://doi.org/10.1016/j.gfs.2017.06.002.

Leeuwis, C., Schut, M., Waters-Bayer, A., Mur, R., Atta-Krah, K., Douthwaite, B., Kruijssen, F., Triomphe, B., Ceballos, J., Child, K., et al. (2014). Capacity to innovate from a system CGIAR research program perspective. Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems. Program Brief: AAS- 2014-29, 5.

Lemarchand, R. (2006). Consociationalism and power sharing in Africa: Rwanda, Burundi, and the Democratic Republic of the Congo. African Affairs, 106(422):1–20.

Lilja, N., and Dixon, J. (2008). Responding to the challenges of impact assessment of participatory research and gender analysis. Experimental Agriculture, 44(01):3–19.

Lubell, M., Niles, M., and Hoffman, M. (2014). Extension 3.0: Managing agricultural knowledge systems in the network age. Society & Natural Resources, 27(10):1089–1103.

Lundy, M., Le Borgne, E., Birachi, E.A., Cullen, B., Boogaard, B., Adekunle, A., and Victor, M. (2013). Monitoring innovation platforms. https://cgspace.cgiar.org/handle/10568/34159

Lusher, D., Koskinen, J., and Robins, G. (2012). Exponential Random Graph Models for Social Networks: Theory, methods, and applications. Cambridge University Press.

Magesa, S.M., Lengeler, C., DeSavigny, D., Miller, J.E., Njau, R.J.A., Kramer, K., Kitua, A., and Mwita, A. (2005). Creating an 'enabling environment' for taking insecticide treated nets to national scale: The Tanzanian experience. Malaria Journal, 4(1), 34. DOI: 10.1186/1475-2875-4-34

Malinsky, E., and Lubelsky, C. (2011). Network evaluation: Cultivating healthy networks for social change. Toronto Centre for Social Innovation. http://socialinnovation.ca/networkevaluation

Mallett, R., Hagen-Zanker, J., Slater, R., and Duvendack, M. (2012). The benefits and

challenges of using systematic reviews in international development research. Journal of Development Effectiveness, 4(3):445–455.
Mango, N., Makate, C., Lundy, M., Siziba, S., Nyikahadzoi, K., and Fatunbi, A.O. (2017). Collective market participation for improved income among smallholder farming households: A case of Balaka innovation platform in Malawi. African Crop Science Journal, 25(1):97–108.
Martey, E., Etwire, P.M., Wiredu, A.N., and Dogbe, W. (2014). Factors influencing willingness to participate in multi-stakeholder platform by smallholder farmers in northern Ghana: Implication for research and development. Agricultural and Food Economics, 2(1):11. DOI: 10.1186/s40100-014-0011-4
Martin, A., Chancellor, T., and Posthumus, H. (2013). A systematic review on the impacts of capacity strengthening of agricultural research systems for development and the conditions of success. Report, Social Science Research Unit, Institute of Education, University of London.
Mayangsari, L., and Novani, S. (2015). Multi-stakeholder co-creation analysis in smart city management: An experience from Bandung, Indonesia. Procedia Manufacturing, 4:315–321.
McDonald, S.-K., Keesler, V.A., Kauffman, N.J., and Schneider, B. (2006). Scaling-up exemplary interventions. Educational Researcher, 35(3):15–24.
McHugh, M., Shi, Y., McClellan, S.R., Shortell, S.M., Fareed, N., Harvey, J., Ramsay, P., and Casalino, L.P. (2016). Using multi-stakeholder alliances to accelerate the adoption of health information technology by physician practices. Healthcare, 4:86–91.
Merrey, D.J. (2013). Is research for development a good investment? Reflections on lessons from the NBDC. Technical report, ILRI.
Messely, L., Rogge, E., and Dessein, J. (2013). Using the rural web in dialogue with regional stakeholders. Journal of Rural Studies, 32:400–410.
Meyer, S., Glaser, B., and Quicker, P. (2011). Technical, economical, and climate-related aspects of biochar production technologies: A literature review. Environmental Science and Technology, 45(22):9473–9483.
Millar, J., and Connell, J. (2010). Strategies for scaling out impacts from agricultural systems change: The case of forages and livestock production in Laos. Agriculture and Human Values, 27(2):213–225.
Moore, M.L. and Westley, F. (2011). Surmountable chasms: Networks and social innovation for resilient systems. Ecology and Society, 16(1). DOI: 10.5751/ES-03812-160105Moreyra, A., and Wegerich, K. (2006). Highlighting the multiple in MSPs: The case of Cerro Chapelco, Patagonia, Argentina. Water Resources Development, 22(4):629–642.
Mortensen, P.S., Bloch, C.W (2005). Oslo Manual – Guidelines for collecting and interpreting innovation data: Proposed guidelines for collecting and interpreting

innovation data. Organization for Economic Cooperation and Dvelopment, OECD.
Muchunguzi, P., van Asten, P., Vanlauwe, B., and Blomme, G. (2016). Overcoming Challenges for Crops, People and Policies in Central Africa. The story of CIALCA stakeholder engagement. Routledge.
Munoz-Erickson, T.A., and Cutts, B.B. (2016). Structural dimensions of knowledge-action networks for sustainability. Current Opinion in Environmental Sustainability, 18:56–64.
Munyua, H. (2007). ICTs and small-scale agriculture in Africa: A scoping study. International Development Research Center (IDRC). http://agris.fao.org/agris-search/search.do?recordID=GB2013201719
Narrod, C., Roy, D., Okello, J., Avendaio, B., Rich, K., and Thorat, A. (2009). Public–private partnerships and collective action in high value fruit and vegetable supply chains. Food Policy, 34(1):8–15.
Nederlof, E.S., Wongtschowski, M., and van der Lee, F. (2011). Putting heads together: Agricultural innovation platforms in practice. KIT, Amsterdam.
Neef, A., and Neubert, D. (2011). Stakeholder participation in agricultural research projects: A conceptual framework for reflection and decision-making. Agriculture and Human Values, 28(2):179–194.
Nikitina, E., Ostrovskaya, E., and Fomenko, M. (2010). Towards better water governance in river basins: Some lessons learned from the Volga. Regional Environmental Change, 10(4):285–297.
Njuki, J., Pali, P., Nyikahadzoi, K., Olaride, P., and Adekunle, A. (2010). Monitoring and evaluation strategy for the sub-Saharan Africa challenge program. Forum for Agricultural Research in Africa (FARA).
Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V., and Van den Oord, A. (2007). Optimal cognitive distance and absorptive capacity. Research Policy, 36(7):1016–1034.
Norman, D. (2002). The farming systems approach: A historical perspective. Presentation at the 17th Symposium of the International Farming Systems Association in Lake Buena Vista, Florida, USA, pages 17–20.
North, D., and Smallbone, D. (2000). Innovative activity in SMEs and rural economic development: Some evidence from England. European Planning Studies, 8(1):87–106.
Nuyens, Y. (2007). Setting priorities for health research: Lessons from low-and middle-income countries. Bulletin of the World Health Organization, 85(4):319–321.
Opondo, C., Sangingab, P., and Strouda, A. (2003). Monitoring the outcomes of participatory research in natural resources management experiences of the African highlands initiative. Advancing Participatory Technology Development: Case Studies on Integration into Agricultural Research, Extension and Education,39–60. http://www.worldagroforestry.org/programmes/african-highlands/pdfs/wps/ahi-

wp_02.pdf
Pachico, D. (2004). Scaling Up and Out: Achieving widespread impact through agricultural research, volume 3. CIAT.
Paina, L., and Peters, D.H. (2012). Understanding pathways for scaling up health services through the lens of complex adaptive systems. Health Policy and Planning, 27(5):365–373.
Pali, P., and Swaans, K. (2013). Guidelines for Innovation Platforms: Facilitation, monitoring and evaluation. ILRI Manual 8. Nairobi, Kenya: ILRI. https://cgspace.cgiar.org/handle/10568/27871
Pamuk, H., Bulte, E., Adekunle, A.A., and Diagne, A. (2014). Decentralized innovation systems and poverty reduction: Experimental evidence from central Africa. European Review of Agricultural Economics, DOI: 10.1093/erae/jbu007.
Payne, S.L., and Calton, J.M. (2002). Towards a managerial practice of stakeholder engagement: Developing multi-stakeholder learning dialogues. The Journal of Corporate Citizenship, 6:37–53.
Poulton, C., and Macartney, J. (2012). Can public–private partnerships leverage private investment in agricultural value chains in Africa? A preliminary review. World Development, 40(1):96–109.
Prell, C., Hubacek, K., Quinn, C.H., and Reed, M. (2008). Who's in the network? When stakeholders influence data analysis. Systemic Practice and Action Research, 21(6):443–458.
Prell, C., Hubacek, K., and Reed, M. (2009). Stakeholder analysis and social network analysis in natural resource management. Society and Natural Resources, 22(6):501–518.
Pretty, J.N., Noble, A.D., Bossio, D., Dixon, J., Hine, R. E., De Vries, F. W. T. P., and Morison, J. I. L. (2006). Resource-conserving agriculture increases yields in developing countries. Environmental Science and Technology, 40(4):1114–1119.
Raford, N. (2015). Online foresight platforms: Evidence for their impact on scenario planning & strategic foresight. Technological Forecasting and Social Change, 97:65–76.
Ragin, C. C. (2014). The comparative method: Moving beyond qualitative and quantitative strategies. University of California Press.
Reed, M., Evely, A.C., Cundill, G., Fazey, I.R.A., Glass, J.H., Laing, A., Newig, J., Parrish, B., Prell, C., and Raymond, C.L. (2010). What is social learning? Ecology and Society, 15(4) http://www.ecologyandsociety.org/volXX/issYY/artZZ/Reypens, C., Lievens, A., and Blazevic, V. (2016). Leveraging value in multi-stakeholder innovation networks: A process framework for value co-creation and capture. Industrial Marketing Management, 56:40–50.
Richardson, J.M., and Grose, J. (2013). An action learning approach to partnership in community development: A reflection on the research process. Action Learning:

Research and Practice, 10(3):254–263.
Rivera, W.M., and Sulaiman, V.R. (2009a). Extension: Object of reform, engine for innovation. Outlook on Agriculture, 38(3):267–273.
Rivera, W.M., and Sulaiman, V.R. (2009b). Extension: Object of reform, engine for innovation. Technical Report 3, FAO.
Rogers, E.M. (2010). Diffusion of Innovations. Simon and Schuster.
Roling, N. (1994). Platforms for decision making about eco-systems. In The Future of the land: Mobilising and integrating knowledge for land use options, LO Fresco et al.(eds.)., pages 385–394. Wiley, Chichester, UK.
Roling, N., and Woodhill, A. (2010). From paradigms to practice: Foundations, principles and elements for dialogue, water, food and the environment. Background document for the national and basin design workshop organised in Bonn on December 1 and 2, 2001. Technical report, the Consortium Dialogue on Water, Food and the Environment. 2010
Roling, N.G., and Wagemakers, M.A.E. (2000). Facilitating Sustainable Agriculture: Participatory learning and adaptive management in times of environmental uncertainty. Cambridge University Press.
Roloff, J. (2008). Learning from multi-stakeholder networks: Issue-focussed stakeholder management. Journal of Business Ethics, 82(1):233–250.
Rosenblatt, G. (2013). The engagement pyramid: Six levels of connecting people and social change. https://mobilisationlab.org/wp-content/uploads/2015/11/Engagement-Pyramid_MobLab.pdf
Rosenfield, P.L. (1992). The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. Social Science & Medicine, 35(11):1343–1357.
Rothenberger, D., Frei, U., and Brugger, F. (2005). Policy principles and implementation guidelines for private sector participation in the water sector step towards better results. Water Science and Technology, 51(8):61–69.
Sagasti, F.R. (1989). Science and technology policy research for development: An overview and some priorities from a Latin American perspective. Bulletin of Science, Technology & Society, 9(1):50–60.
Sanginga, P.C., Chitsike, C.A., Njuki, J., Kaaria, S., and Kanzikwera, R. (2007). Enhanced learning from multi-stakeholder partnerships: Lessons from the enabling rural innovation in Africa programme. Natural Resources Forum, 31: 273–285.
Sanyang, S., Taonda, S.J.B., Kuiseu, J., Coulibaly, N., and Konato, L. (2015). A paradigm shift in African agricultural research for development: The role of innovation platforms. International Journal of Agricultural Sustainability, 14(2), 187–213.
Sartas, M., Schut, M., and Leeuwis, C. (2017). Learning System for Agricultural Re search for Development Interventions (LESARD) – Effective documenting, reporting and analysis of performance factors in multi-stakeholder processes, pages

367–380. Earthscan, Ibadan.
Sauser, B., Verma, D., Ramirez-Marquez, J., and Gove, R. (2006). From TRL to SRL: The concept of systems readiness levels. Paper presented at the Conference on Systems Engineering Research, Los Angeles, CA, April 7–8.
Saysel, A.K., Barlas, Y., and Yenigun, O. (2002). Environmental sustainability in an agricultural development project: A system dynamics approach. Journal of Environmental Management, 64(3):247–260.
Schneider, F., Steiger, D., Ledermann, T., Fry, P., and Rist, S. (2012). Notillage farming: Co-creation of innovation through network building. Land Degradation and Development, 23(3):242–255.
Schot, J., and Geels, F.W. (2008). Strategic niche management and sustainable innovation journeys: Theory, findings, research agenda, and policy. Technology Analysis & Strategic Management, 20(5):537–554.
Schut, M., Cadilhon, J.J., Misiko, M., and Dror, I. (2016a). Do mature innovation platforms make a difference in agricultural research for development? A meta-analysis of case studies. Experimental Agriculture, 1–24.
Schut, M., Kamanda, J., Gramzow, A., Dubois, T., Stoian, D., Andersson, J.A., Dror, I., Sartas, M., Mur, R., Kassam, S., Brouwer, H. (2018). Innovation platforms in agricultural research for development: Ex-ante appraisal of the purposes and conditions under which innovation platforms can contribute to agricultural development outcomes. Experimental Agriculture, Jun:1–22.
Schut, M., Klerkx, L., Rodenburg, J., Kayeke, J., Hinnou, L.C., Raboanarielina, C.M., Adegbola, P.Y., van Ast, A., and Bastiaans, L. (2015). RAAIS: Rapid appraisal of agricultural innovation systems (part i). A diagnostic tool for integrated analysis of complex problems and innovation capacity. Agricultural Systems, 132:1–11.
Schut, M., Klerkx, L., Sartas, M., Lamers, D., Mc Campbell, M., Ogbonna, I., Kaushik, P., Atta-Krah, K., and Leeuwis, C. (2016b). Innovation platforms: Experiences with their institutional embedding in agricultural research for development. Experimental Agriculture, 52(4):537–561.
Schut, M., Soares, N. C., van de Ven, G., and Slingerland, M. (2014). Multi-actor governance of sustainable biofuels in developing countries: The case of Mozambique. Energy Policy, 65:631–643.
Schut, M., van Asten, P., Okafor, C.O., Hicintuka, C., Mapatano, S., Nabahungu, N. L., Kagabo, D., Muchunguzi, P., Njukwe, E., Dontsop-Nguezet, P.M., Sartas, M., and Vanlauwe, B. (2016c). Sustainable intensification of agricultural systems in the central African highlands: The need for institutional innovation. Agricultural Systems, 145:165–176.
Schut, M., van Paassen, A., Leeuwis, C., and Klerkx, L. (2013). Towards dynamic research configurations: A framework for reflection on the contribution of research to policy and innovation processes. Science and Public Policy, 41(2):207–218.

Selfa, T.L., Goe, R., Kulcsar, L., Middendorf, G., and Bain, C. (2013). The biofuels revolution: Understanding the social, cultural and economic impacts of biofuels development on rural communities. Report, Kansas State University.
Sena, A., Ebi, K.L., Freitas, C., Corvalan, C., and Barcellos, C. (2017). Indicators to measure risk of disaster associated with drought: Implications for the health sector. PloS One, 12(7):e0181394.
Smink, M., Negro, S.O., Niesten, E., and Hekkert, M.P. (2015). How mismatching institutional logics hinder niche–regime interaction and how boundary spanners intervene. Technological Forecasting and Social Change, 100:225–237.
Smith, A., Fressoli, M., and Thomas, H. (2014). Grassroots innovation movements: Challenges and contributions. Journal of Cleaner Production, 63:114–124.
Smith, T.M. and Fischlein, M. (2010). Rival private governance networks: Competing to define the rules of sustainability performance. Global Environmental Change, 20(3):511–522.
Smits, R. (2002). Innovation studies in the 21st century; Questions from a user's perspective. Technological Forecasting and Social Change, 69(9):861–883.
Snijders, T.A. (2011). Statistical models for social networks. Annual Review of Sociology, 37 (1) 131–153. https://doi.org/10.1146/annurev.soc.012809.102709
Sokal, R.R. and Rohlf, F.J. (1969). Biometrythe principles and practice of statistics in biological research. Technical report, WH Freeman.
Spielman, D.J., Davis, K., Negash, M., and Ayele, G. (2011). Rural innovation systems and networks: Findings from a study of Ethiopian smallholders. Agriculture and Human Values, 28(2):195–212.
Spielman, D.J., Ekboir, J., and Davis, K. (2009). Developing the Art and Science of Innovation Systems Enquiry: Alternative tools and methods, and applications to sub-Saharan African agriculture. Earthscan.
Spielman, D.J., Ekboir, J., Davis, K., and Ochieng, C.M. (2008). An innovation systems perspective on strengthening agricultural education and training in sub-Saharan Africa. Agricultural Systems, 98(1):1–9.
Spielman, D.J., Hartwich, F., and Grebmer, K. (2010). Public–private partnerships and developing-country agriculture: Evidence from the international agricultural research system. Public Administration and Development, 30(4):261–276.
Steinmann, P., Keiser, J., Bos, R., Tanner, M., and Utzinger, J. (2006). Schistosomiasis and water resources development: Systematic review, meta-analysis, and estimates of people at risk. Lancet Infectious Diseases, 6(7):411–425.
Steins, N.A. and Edwards, V.M. (1999). Platforms for collective action in multiple-use common-pool resources. Agriculture and Human Values, 16(3):241–255.
Steyaert, P., Barzman, M., Billaud, J. P., Brives, H., Hubert, B., Ollivier, G., and Roche, B. (2007). The role of knowledge and research in facilitating social learning among stakeholders in natural resources management in the French Atlantic coastal wet-

lands. Environmental Science & Policy, 10(6):537–550.
Stringer, L.C., Dougill, A.J., Dyer, J.C., Vincent, K., Fritzsche, F., Leventon, J., Falcao, M.P., Manyakaidze, P., Syampungani, S., and Powell, P. (2014). Advancing climate compatible development: lessons from southern Africa. Regional Environmental Change, 14(2):713–725.
Stuer, W., Phengsavanh, P., Stelling, A., Millar, J., and Lefroy, R. (2009). Facilitating a multi-stakeholder learning alliance: A case study describing the activities, outputs and impact of the pig systems development alliance in Lao PDR. Paper presented at the Innovation Asia-Pacific Symposium, 4–7.Sumberg, J., Heirman, J., Raboanarielina, C., and Kaboré, A. (2013). From agricultural research to 'product development' what role for user feedback and feedback loops? Outlook on Agriculture, 42(4):233–242.
Suurs, R.A. (2009). Motors of Sustainable Innovation: Towards a theory on the dynamics of technological innovation systems. Utrecht University.
Swanson, B.E., and Samy, M.M. (2002). Developing an extension partnership among public, private, and nongovernmental organizations. Journal of International Agricultural and Extension Education, 9(1):5–10.
Tacoli, C. (1998). Rural–urban interactions: A guide to the literature. Environment and Urbanization, 10(1):147–166.
Tenywa, M.M., Rao, K.P.C., Tukahirwa, J.B., Buruchara, R., Adekunle, A.A., Mugabe, J., Wanjiku, C., Mutabazi, S., Fungo, B., and Kashaija, N.I.M. (2012). Agricultural innovation platform as a tool for development-oriented research: Lessons and challenges in the formation and operationalization. World Applied Sciences Journal, 16(7):981–988.
Thiele, G., Devaux, A., Reinoso, I., Pico, H., Montesdeoca, F., Pumisacho, M., Andrade-Piedra, J., Velasco, C., Flores, P., Esprella, R., et al. (2011). Multi-stakeholder platforms for linking small farmers to value chains: Evidence from the Andes. International Journal of Agricultural Sustainability, 9(3):423–433.
Thompson, G.D., Dutton, R., and Sparks, T.C. (2000). Spinosad - a case study: An example from a natural products discovery programme. Pest Management Science, 56(8):696–702.
Thornton, P.H., Ocasio, W., and Lounsbury, M. (2012). The Institutional Logics Perspective: A new approach to culture, structure, and process. Oxford University Press on Demand.
Tittonell, P., Scopel, E., Andrieu, N., Posthumus, H., Mapfumo, P., Corbeels, M., Van Halsema, G.E., Lahmar, R., Lugandu, S., and Rakotoarisoa, J. (2012). Agro-ecology-based aggradation-conservation agriculture (abaco): Targeting innovations to combat soil degradation and food insecurity in semi-arid Africa. Field Crops Research, 132:168–174.
Triomphe, B., Floquet, A., Kamau, G., Letty, B., Vodouhe, S. D., Ng'ang'a, T., Stevens, J., Van Den Berg, J., Selemna, N., and Bridier, B. (2013). What does an inventory of recent innovation experiences tell us about agricultural innovation in Africa? The Journal of Agricultural Education and Extension, 19(3):311–324.
Uvin, P., Jain, P.S., and Brown, L.D. (2000). Think large and act small: Toward a new paradigm for NGO scaling up. World Development, 28(8):1409–1419.
Valente, T.W. (2005). Network models and methods for studying the diffusion of innovations. Models and methods in social network analysis, 28:98. DOI: 10.1017/CBO9780511811395.006
Valente, T.W. (2012). Network interventions. Science, 337(6090):49–53.
Van Damme, J. (2013). Analyse systémique des processus d'innovation dans les systèmes agraires de la région des grands lacs basés sur la culture de la banane. Université catholique de Louvain, Louvain-la-Neuve, Belgique.
van der Valk, T. (2007). Technology dynamics, network dynamics and partnering. The case of Dutch dedicated life sciences firms (360) 1–141, https://www.scopus.com/inward/record.uri?eid=2-s2.0-35048870609&partnerID=40&md5=9030ba7a4e7ff3ef3fa1359d0d40bcdf
Van Mierlo, B., Regeer, B., van Amstel, M., Arkesteijn, M., Beekman, V., Bunders, J., de Cock Buning, T., Elzen, B., Hoes, A.C., and Leeuwis, C. (2010). Reflexive monitoring in action. A guide for monitoring system innovation projects. Technical report, Communication and Innovation Studies, WUR; Athena Institute, VU.
van Mierlo, B.C., and Totin, E. (2014). Between script and improvisation: institutional conditions and their local operation. Outlook on Agriculture, 43(3):157–163.
Van Paassen, A., Klerkx, L., Adu-Acheampong, R., Adjei-Nsiah, S., and Zannoue, E. (2014). Agricultural innovation platforms in West Africa: How does strategic institutional entrepreneurship unfold in different value chain contexts? Outlook on Agriculture, 43(3):193–200.
Vanlauwe, B., Van Asten, P., and Blomme, G. (2013). Agro-Ecological Intensification of Agricultural Systems in the African Highlands. Routledge.
Vassal, G., Rousseau, R., Blanc, P., Moreno, L., Bode, G., Schwoch, S., Schrappe, M., Skolnik, J., Bergman, L., and Bradley-Garelik, M.B. (2015). Creating a unique, multi-stakeholder pediatric oncology platform to improve drug development for children and adolescents with cancer. European Journal of Cancer, 51(2):218–224.
Verhagen, J., Butterworth, J., and Morris, M.C. (2008). Learning alliances for integrated and sustainable innovations in urban water management. Waterlines, 27(2):116–124.
Viera, A.J., and Garrett, J.M. (2005). Understanding interobserver agreement: The kappa statistic. Family Medicine, 37(5):360–363.
Walker, B.H., Sayer, J., Andrew, N.L., and Campbell, B.L. (2010). Should enhanced resilience be an objective of natural resource management research for developing countries? Crop Science, 50(Supplement1): S-10-S-19.

Warner, J. (2006a). Multi-stakeholder platforms: Integrating society in water resource management? Ambiente & Sociedade, 8(2):4–28.

Warner, J.F. (2006b). More sustainable participation? Multi-stakeholder platforms for integrated catchment management. Water Resources Development, 22(1):15–35.

Warner, J. (2007). The beauty of the beast: Multi-stakeholder participation for integrated catchment management. Multi-stakeholder platforms for integrated water management, 17–36, Routledge Press

Wasserman, S., and Faust, K. (1994). Social Network Analysis: Methods and applications (Vol 8), Cambridge University Press.

Weber, K.M., and Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework. Research Policy, 41(6):1037–1047.

Wellbrock, W., Roep, D., Mahon, M., Kairyte, E., Nienaber, B., Garcıa, M.D.D., Kriszan, M., and Farrell, M. (2013). Arranging public support to unfold collaborative modes of governance in rural areas. Journal of Rural Studies, 32:420–429.

Whitworth, J.A.G., Kokwaro, G., Kinyanjui, S., Snewin, V.A., Tanner, M., Walport, M., and Sewankambo, N. (2008). Strengthening capacity for health research in Africa. The Lancet, 372(9649):1590–1593.

Wigboldus, S., Klerkx, L., Leeuwis, C., Schut, M., Muilerman, S., and Jochemsen, H. (2016). Systemic perspectives on scaling agricultural innovations. A review. Agronomy for Sustainable Development, 36(3):46. DOI: 10.1007/s13593-016-0380-z

Wong, L.P., AbuBakar, S., and Chinna, K. (2014). Community knowledge, health beliefs, practices and experiences related to dengue fever and its association with igg seropositivity. PLoS Neglected Tropical Diseases, 8(5):e2789.

Wood, B.A., Blair, H.T., Gray, D.I., Kemp, P.D., Kenyon, P.R., Morris, S.T., and Sewell, A.M. (2014). Agricultural science in the wild: A social network analysis of farmer knowledge exchange. PloS One, 9(8):e105203.

Woolthuis, R.K., Lankhuizen, M., and Gilsing, V. (2005). A system failure framework for innovation policy design. Technovation, 25(6):609–619.

Yasuoka, J., and Levins, R. (2007). Impact of deforestation and agricultural development on anopheline ecology and malaria epidemiology. The American Journal of Tropical Medicine and Hygiene, 76(3):450–460.

Yildirim, O., Gottwald, M., Schueler, P., and Michel, M.C. (2016). Opportunities and challenges for drug development: Public–private partnerships, adaptive designs and big data. Frontiers in Pharmacology 7, 461. https://doi.org/10.3389/fphar.2016.00461

Zinsstag, J., Schelling, E., Waltner-Toews, D., and Tanner, M. (2011). From one medicine to one health and systemic approaches to health and well-being. Preventive Veterinary Medicine, 101(3):148–156.

Zornes, D., Ferkins, L., and Piggot-Irvine, E. (2016). Action research networks: Role and purpose in the evaluation of research outcomes and impacts. Educational Action Research, 24(1):97–114.

Zuurbier, P.J.P. (2010). Sustainability and certification in the biofuels sector: Some critical observations. In 9th Wageningen International Conference on Chain and Network Management Proceedings. https://library.wur.nl/WebQuery/wurpubs/fulltext/163164

Summary

This thesis studies the contribution of multi-stakeholder platforms (MSP) to the performance of research for development (R4D) interventions. MSPs are increasingly being utilized as a management and stakeholder engagement approach in R4D interventions. However, whether and how they contribute to R4D interventions, and which factors play a role, has not been systematically assessed. The thesis investigates the ways in which MSPs can contribute to R4D interventions and explores the factors that influence the contribution of MSPs. In order to capture the contributions systematically, it develops a new research approach by combining action research and qualitative and quantitative methods in a systematic manner.

The thesis focuses on two aspects, (1) process outputs and (2) their drivers, where the contribution of MSPs can be observed during different types of R4D interventions. Regarding the former, the network analysis approach is used to study major process outputs, i.e. collaboration, knowledge exchange, and influence spread. Regarding the latter, drivers that lead to changes in process outputs, i.e. participation, shared understanding, engagement, and learning, are quantified.
The thesis shows that MSPs do not necessarily increase collaboration in innovation networks. They may have no major impact in enhancing such networks, but they can make positive contributions to the knowledge networks targeted by R4D interventions. It also indicates that MSPs can contribute to stakeholders' shared understanding and learning. However, its contribution to participation and engagement are highly dependent on periodic cycles. In addition, it shows that the factors that influence the process outcomes and their drivers vary.

The thesis synthesizes four different empirical studies organized as research papers and concludes that:

- Using the theory of change to study MSPs' contribution to R4D intervention performance can improve study results
- Comprehensive understanding of the contribution of MSPs to the performance of R4D interventions requires mixed-method approaches
- R4D interventions with MSPs lead to extension of existing process configurations
- Initial selection of the stakeholders to be represented in an MSP constrains the contribution of the MSP
- The MSP approach is not conducive to R4D interventions that require the engagement of a broader stakeholder base
- The MSP approach is not conducive to R4D interventions aiming at transformative change.

About the author

Murat Sartas was born on 12 October 1982 in Ankara, Turkey. He grew up in a sub-urb of Ankara, where he spent his young years playing soccer and exploring Mathematics. After completing his secondary school in Ankara, he took the national university selection exam and qualified for the top School of Architecture as one of the top 1% performers among the 1.5 million students who took the national exam. Afterwards, he went to prep school for a year and learned the English language. In 2000, he studied a fundamental course at the School of Architecture and decided to change his department as architectural studies did not satisfied his expectations. In 2001, he retook the national exam and graduate as one of the top 2000 performers of the national exam. Following his passion of Mathematics and interest in social sciences, he decided to register for the School of Economics in late 2001. He performed well in the School of Economics and was awarded a bachelor's degree in economics as a high honors student. He also finished a double major degree in the Department of International Relations with a specialization on the European Union at the same time in the Middle East Technical University.

In 2005, he started to work in the private sector preparing and managing international development projects implemented in Turkey and started to do his master's program in quantitative economics in the Middle East Technical University. After three years, he started to work in Eastern Turkey as international compliance officer for an international gold mine. He designed and implemented data management systems reporting on the environmental, social, economic, and cultural impact of the gold mine to the International Finance Cooperation of the World Bank.

In 2010, he decided to pursue further studies in Europe and qualified as an MSc student for a double degree European Master Program Agricultural, Food and Environmental Policy Analysis program led by Université Catholique de Louvain (UCL), Belgium. In 2012, he finished an MSc in Agricultural Economics in the Swedish University of Agricultural Science and another one in the University of Bonn, Germany, on agribusiness and food value chains. As part of his MSc studies, Murat conducted an internship in Botswana on a research for development project on an indigenous plant of the Kalahari Desert and started his professional adventure in Africa.

Between 2012 and 2014, Murat worked as a part-time research assistant in the Swedish University of Agriculture. He completed short-term research tasks in Botswana, Malawi, Mozambique, Namibia, South Africa, and Tanzania and civil society work in Cameroon and Ghana until mid-2014 when he started his work at the International Institute of Tropical Agriculture as well as his PhD studies at Wageningen University. He

studies multi-stakeholder processes in research for development contexts in African countries. Recently, Murat has been doing research on innovation systems and innovation delivery systems in the global tropics and has developed decision support tools for interventions aiming to improve innovation and livelihood systems such as Learning System for Agricultural Research Development (LESARD) and Scaling Readiness.

Peer-reviewed journal publications

Sartas, M., Schut, M., Hermans, F., van Asten, P., and Leeuwis, C. (2018). Effects of multi-stakeholder platforms on multi-stakeholder innovation networks: Implications for research for development interventions targeting innovations at scale. PloS One, 13(6):e0197993.

Schut, M., Kamanda, J., Gramzow, A., Dubois, T., Stoian, D., Andersson, J.A., Dror, I., Sartas, M., Mur, R., Kassam, S., and Brouwer, H. (2018). Innovation platforms in agricultural research for development: Ex-ante appraisal of the purposes and conditions under which innovation platforms can contribute to agricultural development outcomes. Experimental Agriculture, Jun:1–22.

Hermans, F., Sartas, M., Van Schagen, B., van Asten, P., and Schut, M. (2017). Social network analysis of multi-stakeholder platforms in agricultural research for development: Opportunities and constraints for innovation and scaling. PloS One, 12(2):e0169634.

Schut, M., Klerkx, L., Sartas, M., Lamers, D., Mc Campbell, M., Ogbonna, I., ... and Leeuwis, C. (2016). Innovation platforms: Experiences with their institutional embedding in agricultural research for development. Experimental Agriculture, 52(4):537–561.

Schut, M., van Asten, P., Okafor, C., Hicintuka, C., Mapatano, S., Nabahungu, N. L., ... and Sartas, M. (2016). Sustainable intensification of agricultural systems in the Central African Highlands: The need for institutional innovation. Agricultural Systems, 145:165–176.

ChiwonaKarltun, L., Kimanzu, N., Clendenning, J., Lodin, J.B., Ellingson, C., Lidestav, G., Mkwambisi, D., Mwangi, E., Nhantumbo, I., Ochieng, C., Petrokofsky, G., and Sartas, M. (2017). What is the evidence that gender affects access to and use of forest assets for food security? A systematic map protocol. Environmental Evidence, 6(1),2.

Peer-reviewed book chapters

Sartas, M., Schut, M., and Leeuwis, C. (2017). Learning System for Agricultural Research for Development (LESARD): Documenting, reporting, and analysis of performance factors in multi-stakeholder processes. In Sustainable Intensification in Smallholder Agriculture: An integrated systems research approach. Earthscan Food and Agriculture, First edited by Oborn Ingrid, Vanlauwe Bernard, Philips Michael, Thomas Richard, Brooijmans Willemien, Atta-Krah Kwesi, 02/2017: chapter 25: pages 367–380; Earthscan.

Namazzi, S., Muchunguzi, P., Lamers, D. Sole-Amat, A.,van Asten, P., Dubois, T. Afari-Sefa V., Tenywa, M. Mugisa, I. McCampbell, M., and Sartas, M. (2015). Crop–livestock–tree Integration in Uganda: The case of Mukono-Wakiso innovation platform. Innovation Platforms for Agricultural Development: Evaluating the mature innovation platforms landscape, edited by Iddo Dror, Jean-Joseph Cadilhon, Marc Schut, Michael Misiko, Shreya Maheshwari, 09/2015: chapter 5; Routledge.

Other scientific publications

Elinor, H., Sartas, M., Röös, E., Koca, D., and Börjesson, P. (2015). How much meat can we eat to sustain a healthy life and planet? The case of Swedish meat consumption. 2015 ENEA Italian National Agency for New Technologies, Energy and Sustainable Economic Development Lungotevere Thaon di Revel, 76 00196 Roma, 29.

Murat Sartas

Wageningen School of Social Sciences (WASS)

Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A. Project related competences			
Participatory Agricultural Research: Approaches Design and Evaluation	OXFORD/Saint Anne Collage	2013	1.75
Scaling and Institutional Innovation, Humidtropics SRT3 (Workshop)	WUR/CPT/KTI	2013	0.8
Systematic reading of innovation systems literature	WUR/CPT/KTI	2014	5
Research Design Meeting	CGIAR IITA/Uganda	2014	0.5
Social and Economic Networks: Models and Analysis	Cousera, Stanford Uni/Economics	2016	3
Systems thinking in Public Health	Coursera, John Hopkins/ Medicine	2016	1
Statistics with R	Michigan Uni/Economics	2018	3
'The Stepping Stones to Success: How We Achieve High Ownership and Reflective Learning in Multistakeholder Processes in Uganda?'	International Conference on Integrated Systems Research At: Ibadan, Nigeria	2015	1
'Effects of Multi-stakeholder Platforms (MSP) on Innovation Networks and Implications for Research for Development (R4D) in Agriculture'	Nigeria/Systems Research Marketplace. Partnership for Development Conference	2016	1
'Scaling Readiness. An approach to assess and accelerate Scaling of Innovations'	ITTA, Transforming African Agricultures, Nigeria, Tanzania	2017	1
'Social Network Approach for Guiding and Leveraging R4D Investments'	CGIAR RTB program conference, Tanzania	2017	1
B. General research related competences			
Geographic information systems and geographical analysis	SLU/Geoinformatics	2013	7.5
Quantitative and Qualitative approaches to synthesis	Utrecht/SBS	2014	0.6
Reflexive monitoring and transformative change	WUR/CPT	2014	0.3
Scientific Publishing	WUR/LIB	2014	0.3
Data Management	WUR/LIB	2014	0.6
Teaching in the workshop, Systems approaches to innovation and basics of multi-stakeholder platform	China/Training Workshop	2014	1
Teaching in Humidtropics blended learning course for facilitators of innovation platform from Thailand, China, Vietnam, Laos	Vietnam/Training Workshop	2015	1
Teaching in a workshop on Social Network analysis in research for development	Uganda/Training Workshop	2017	1
Teaching in Scaling Fund Workshop about Scaling readiness in Action	Nairobi/Training Workshop	2018	1
Total			32.35

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

CGIAR IITA: International Institute of Tropical Agriculture

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