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Unpacking systemic innovation capacity as strategic ambidexterity: How projects dynamically configure capabilities for agricultural innovation

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ABSTRACT

Problems in agriculture and land use are increasingly recognised as complex, uncertain, operating at multiple levels (field to global value chains) and involving social, economic, institutional, and technological change. This has implications for how projects navigate complexity to achieve impact. However, few studies have systematically evaluated how project actors engage with other actors to configure capabilities and resources across multiple levels in agricultural innovation systems (AIS), from the individual to the network, to mobilise and build systemic innovation capacity. An analytical framework conceptualising the nested configuration of capabilities at multiple levels in the AIS is applied to two projects that successfully tackled agricultural and land management problems of differing complexity: (i) improving lamb survival; and (ii) sustainable land management in New Zealand. Findings indicate that innovation capacity constitutes project actors interacting with other AIS actors to configure capabilities and resources at different levels of the AIS in order to leverage positive project path dependencies and break path dependencies that are created by existing and historical capability configurations. Project actors also balance exploiting existing innovation capabilities, as well as using adaptive capability for exploring and creating new capability configurations to respond to emerging circumstances. This implies that projects should have strategic ambidexterity in terms of how they combine exploiting existing and exploring new networks to access, combine, create, or disconnect certain capabilities to address 'capability voids' in AIS. This requires support to projects to constantly scrutinise, through reflexive monitoring by dedicated facilitators, specific agriculture and land use policies connected to major sustainable development models (e.g. climate smart agriculture, urban farming, smart farming). The can help assess whether the AIS provides the right mix of capabilities and whether this is adequately supported by innovation policy, to realize transformative policy objectives.

1. Introduction

Problems in agriculture, and land use more broadly, are increasingly recognised as complex, uncertain, operating at multiple levels (from the field, region and territory, to global value chains). Complex problems in agriculture such as unsustainable land management leading to land degradation and other negative environmental spillovers (Mutoko et al., 2014), dealing with climate change effects on agriculture (Lyle, 2015; Singh et al., 2016), and maintaining rural resilience in times of fast economic, demographic and technological change in rural areas (Darnhofer et al., 2016; Nuthall and Old, 2017), have strong links with land use policy as they affect the way land is used, transformed, distributed and owned. It has become recognised that tackling these complex problems often requires transformative processes with combined social, economic, institutional and technological changes (Elzen et al., 2012; Klerkx et al., 2010; Schut et al., 2014a; Vanclay et al., 2013) and hence coordinated action of multiple actors including farmers, agricultural input and processing industry, land use planners, and environmental organizations (Brown et al., 2016; Läpple et al., 2016; Sutherland et al., 2017; Vanclay et al., 2013). Policy makers concerned with tackling agricultural and sustainable land use problems can use diverse policy instruments, such as setting regulatory

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frameworks and providing direct financial incentives to producers to stimulate desired behaviour with regards to, for example, sustainable agricultural production and land management or climate smart technology adoption (Greiner and Gregg, 2011; Lockie, 2013).

Besides these 'generic' instruments to enact agriculture and land use policies for achieving desired transformations in agricultural production and land management, there are also dedicated innovation policy instruments linked to agriculture and land use policies that include financing dedicated innovation projects in which research is employed to develop new technologies and practices and advisory services are provided to support their uptake by farmers to tackle specific problems (Brown et al., 2016; Klerkx et al., 2017; Vrain and Lovett, 2016). However, to be effective these projects often need to go beyond devising and diffusing new technologies and practices, to be integrated into a wider process of learning, coordination and change of policy and supply chain actors, inducing changes in value distribution models in supply chains and policy and regulatory frameworks (Läpple et al., 2016; Phillipson et al., 2016; Vanclay et al., 2013).

That projects operate in a complex environment that they need to engage with (Manning, 2006, 2017), and which influences their actions and impacts, is contemplated in network and systems approaches to agricultural innovation (Engel, 1995; Ingram, 2015; Lowitt et al., 2015; Oreszczyn et al., 2010), such as agricultural innovation systems (AIS) sometimes also referred to as Agricultural Knowledge and Innovation Systems (AKIS) (Knierim et al., 2015; McDonald and Macken-Walsh, 2016). AIS and AKIS approaches have become increasingly linked to agriculture and land use policies for supporting and achieving transformations in terms of agricultural production and related land management issues, for example in the European Union where the AKIS approach is linked to the Common Agricultural Policy (Brunori et al., 2013; Knierim et al., 2015), and AIS has for example been included in policy recommendations for addressing agriculture and land use issues in the context of Australia and New Zealand (Robertson et al., 2016; Turner et al., 2016).

AIS, the term we will henceforth use in this paper, conceptualises innovation as a co-evolutionary process of interactive development of technology, artefacts, practices, markets, procedures and socio-institutional arrangements (Hall and Clark, 2010; Klerkx et al., 2012), involving actors from different domains (e.g., farmers, policy makers, traders, processors, standard setters, NGOs, and regulatory organisations). While substantial and high quality research and advisory capability may be available in innovation projects, a lack of awareness of how projects are dependent on changes by different actors in an AIS and mobilise these actors to achieve their project goals constrains project contribution to tackling agricultural problems (Hall, 2005; Schut et al., 2015; Wigboldus et al., 2016). Hence, innovation projects need to be able to create or mobilise what has been called systemic innovation capacity (Hall, 2005; Schut et al., 2014a). This is defined as the capability of interdependent and self-organizing actors to continuously identify and prioritise constraints and opportunities, and in response coordinate and collaborate with others to mobilise new and existing knowledge, resources and capabilities, to experiment with social, technical and institutional options (Hall, 2005; Leeuwis et al., 2014; Schut et al., 2014a). Systemic innovation capacity requires that actors in projects evaluate and adaptively respond to changes within the project environment (e.g., the project team, the project team members' organisations), and the external social, technical and institutional environment (i.e., the network of organisations the project directly works with, and stakeholders in the external environment that can influence the project) (Manning, 2006; Beers et al., 2014; Ingram, 2015; Klerkx et al., 2010; Schut et al., 2014a). This external environment consists of several levels and scales, such as administrative levels and geographical scales (Manning, 2006; Schut et al., 2013; Hermans et al., 2015). Limited awareness of and monitoring of these internal and external environments can result in inadequate actions by project actors, hampering success (Beers et al., 2014; Hueske et al., 2015; Klerkx et al., 2010), and thus an inability to achieve the transformative objective these projects have of contributing to tackling challenges such as climate change and rural resilience.

Being an emerging construct, systemic innovation capacity in AIS has not yet been investigated comprehensively in agricultural innovation, and existing work has focused on innovation capacity at specific levels, e.g. individual innovation capacity (often through the lens of entrepreneurship -Hassink et al., 2016; Seuneke et al., 2013), and innovation capacity in or through networks (Oreszczyn et al., 2010). Where studies have considered innovation capacity across AIS levels they have focused on interactions between two to three levels only, such as interactions between individual and organisational capacities (Pant, 2012), or between innovation networks and their external environment (Nettle et al., 2013; Klerkx et al., 2010; Beers et al., 2014; Hermans et al., 2015). Given the lack of a cross level study, our main research question is: how are capabilities at different levels in the AIS configured by innovation projects to successfully mobilise and build systemic innovation capacity? We address this question be developing an analytical framework conceptualising the configuration by project actors of capabilities at multiple levels in the AIS and applying this to two projects that successfully tackled agricultural problems of differing complexity: (i) improving lamb survival; and (ii) sustainable land management in New Zealand.

Understanding and analysing how systemic innovation capacity is built and how it relates to capabilities and resources can help project staff and policy makers to detect gaps in capabilities, in for example research and advisory establishments and more broadly in the portfolio of agricultural innovation policy instruments (see Borrás and Edquist, 2013), which may lead to project failure and an inability to contribute to realising the objectives of agricultural and land use policies. This can inform investment to build capabilities, increase the likelihood of project success, and can become part of foresight, strategy and technology assessment exercises informing agricultural innovation policies (Dwyer, 2011; Thornton et al., 2017; van der Meulen et al., 2003; Vanclay et al., 2013) in order to be able to reconfigure AIS to cope with changing contexts and emerging agricultural and land management challenges to progressing agriculture and land use policy agendas. For example, transformative agriculture and land use policies dealing with sustainable land use, climate change adaptation (Singh et al., 2016) and rural ecological and social resilience (Darnhofer et al., 2016), by stimulating particular models for agricultural production and land use such as sustainable or ecological intensification (Petersen and Snapp, 2015; Pretty et al., 2011; Tittonell et al., 2016), climate smart agriculture (Kpadonou et al., 2017; Long et al., 2016), circular economy and bioeconomy (Kristensen et al., 2016; O'Brien et al., 2017), urban farming (Huang and Drescher, 2015; Pölling et al., 2016) and smart farming based on use of precision technology, Internet of Things, and Big Data (Eastwood et al., 2017; Poppe et al., 2013; Wolfert et al., 2017).

The next section details the analytical framework used for developing a nested understanding of systemic innovation capacity in an AIS. The paper then introduces the two case studies, along with the data and methods of analysis, followed by a presentation of the results as timelines of configurations of capabilities at different levels of the AIS. The case studies indicate that systemic innovation capacity constitutes configuring capabilities and resources at different levels of the AIS to leverage positive project path dependencies and break negative path dependencies due to historical capability configurations. Both case studies also simultaneously exploited existing innovation capabilities and resources, as well as using adaptive capability for exploring and creating new capability configurations to respond to emerging circumstances. We conclude with reflections and implications for theory and practice, arguing that innovation projects should have so-called strategic ambidexterity to combine exploiting existing and exploring new networks to access, combine, create, or disconnect capabilities.