



Editorial

Opening design and innovation processes in agriculture: Insights from design and management sciences and future directions



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ABSTRACT

Research has identified an urgent need to renew agriculture's traditional design organization and foster more open, decentralized, contextualized and participatory approaches to design and innovation. While the concepts of co-design and co-innovation used in agriculture resemble features of open innovation, they may benefit from 'inbound open innovation' themselves through cross-fertilization with management studies, design science, science and technology studies, and organization studies. This special issue brings together different streams of research providing novel perspectives on co-design and co-innovation in agriculture, including methods, tools and organizations. It compares empirical experiences and theoretical advances to address a variety of issues (e.g., innovation ecosystems, collective design management, participatory design methods, affordances of system analysis tools and network leadership) that shed new light on co-design and co-innovation in support of sustainable agriculture and more broadly transitions towards a diversity of food systems and a circular bioeconomy. This introductory paper presents crosscutting insights and distills from these three directions for future research and practice in agricultural design and innovation: 1) Further opening design and innovation techniques and tools to better account for visual, auditory, tactile and olfactory expressions in evolving designs and what they afford users; 2) Further opening innovation networks in view of creating and stimulating integrative niches that can foster sustainability transitions, which also requires network managers instilling a reflexive stance of network members and broader awareness of power structures attached to organizational, sector and paradigmatic silos in agricultural systems; and 3) Further opening the range of innovation actors to include non-human actants to better account for the agency of the material and ecological.

1. Introduction

The need to increase food and raw material production has led many governments to develop efficiency-enhancing agricultural design and technology development organizations, which have been often based on a linear model: scientific and technical knowledge is generally produced in research organizations, further development of technologies is carried out through public and private technical institutes and public and private disseminates innovation to farmers, being the innovation end-users. Such a linear design organization has spectacularly supported the rapid industrialization of agriculture in many nations, stimulating innovations that have greatly increased agricultural yields. However, this model has also been critiqued as generating many negative environmental and social side effects (Vanloqueren and Baret, 2009; Brunori et al., 2013), failing at educating and engaging farmers on ecological issues (De Snoo et al., 2013) and not drawing well on values of progress and innovation that are inherent to farmers (Burton and Paragahawewa, 2011) or other actors in society (Elzen and Bos, 2016), and not seeing agricultural design and innovation as part of broader transitions encompassing a diversity of future food systems (Hinrichs, 2014; Meynard et al., 2017; Plumecocq et al., 2018; Pigford et al., 2018) and part of circular and bioeconomies (Hermans, 2018).

In view of these shortcomings of the linear model, there have been calls to renew agriculture's traditional organization of design and technology development (Vanloqueren and Baret, 2009; Meynard et al., 2017) and foster more open, decentralized, contextualized and participatory approaches to design and technology development, and more broadly innovation in agricultural systems. This echoes an increasing trend in the corporate industrial and technology sectors towards *open innovation*, a concept from management studies emphasizing that knowledge flows come both from within and outside firms, and move inbound and outbound (Chesbrough, 2003), through various network forms of collaboration (West et al., 2006) including alliances, communities, consortia, ecosystems, and platforms. Open innovation requires firms to orchestrate joint value creation and value capture of firms across the network (Vanhaverbeke, 2006; West, 2014) and include more external parties, such as users or suppliers (Schroll and Mild, 2011; Giannopoulou et al., 2011). Open innovation can be supported by innovation intermediaries (Agogué et al., 2013; Klerkx and Aarts, 2013), innovation ecosystems (Adner and Kapoor, 2010) and purposeful strategies deployed by firms to increase their open innovation capabilities (Iansiti and Levien, 2004). Such approaches aim to blur the boundaries between designers and users, emphasizing the importance of community and each actor's freedom and responsibility to exercise

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their knowledge, skills and ethics within innovation processes (Gardien et al., 2014). Open design and innovation approaches in agricultural contexts would therefore blur the boundaries between scientists and agricultural system stakeholders, between agronomists and farmers, and between actors in the agriculture sector and those designing in other sectors.

Recent research into supporting co-design and co-innovation in the agricultural sector has examined how to facilitate knowledge flows between actors and how to better involve a diversity of actors in design and innovation processes within agricultural systems, albeit without generally using the term “open innovation”. Such approaches are referred to as participatory design approaches (Cerf et al., 2012; Berthet et al., 2015) or collaborative design (Barcellini et al., 2015) referred to in this paper as *co-design*, and *co-innovation* (Botha et al., 2017; Dogliotti et al., 2014). Both approaches seek to better account for the diversity of production situations as well as the strong interconnections between the various components of agri-food systems in more systemic ways (Berthet et al., 2016; Biggs et al., 2010; Brunori et al., 2013; Prost et al., 2017). Co-design involves heterogeneous stakeholders in the collective exploration of solutions to a common problem and generally seeks to build and maintain a shared conception of the design problem to allow collaboration (Gardien et al., 2014; Barcellini et al., 2015). Co-innovation promotes collaboration between researchers and stakeholders beyond an initial design phase to realize combined technological and institutional innovation in farming systems, sectors, territories and value chains (Botha et al., 2014, 2017). Research has been conducted on model-based tools and methods that can support co-design and co-innovation at the farm scale (see for example Dogliotti et al., 2004; Cerf et al., 2012; Dogliotti et al., 2014; Le Gal et al., 2011; Speelman et al., 2014) and at the scale of whole systems to foster sustainability transitions (Bos et al., 2009; Elzen and Bos, 2016). Other research has explored the operational challenges associated with participatory research, co-design and co-innovation (see for example Douthwaite and Gummert, 2010; Neef and Neubert, 2011; Sewell et al., 2014; Van Mierlo et al., 2013; Dolinska and D'Aquino, 2016; Botha et al., 2017; Turner et al., 2017), in particular how structural and institutional features of agricultural innovation systems may, or may not, support co-design and innovation processes (see for example Eastwood et al., 2012; Hermans et al., 2015; Schut et al., 2015; Turner et al., 2016), and how actors in agricultural innovation systems may be connected in co-design and innovation processes through innovation intermediaries and/or boundary objects (see for example Jakku and Thorburn, 2010; Klerkx et al., 2010; Tisenkopfs et al., 2015).

In the context of designing more sustainable agricultural and agri-food systems, and in view of paradigms such as multi-functional farming, biobased and circular economy, agroecology, vertical farming, and smart or digital farming (Pigford et al., 2018), there is a need to consider how existing co-design and co-innovation approaches in agriculture can be further opened. This includes a need to better understand, develop and validate novel design methods, tools and techniques capable of supporting both democratic and radical innovation, including concepts, behaviours and technologies (Gardien et al., 2014) among dispersed and autonomous entrepreneurs (farmers), as well as with other actors with diverging interests and complex power relationships (Barnaud and Van Paassen, 2013; Berthet et al., 2016). Considering that research into co-design and co-innovation in agriculture may itself benefit from open innovation, this special issue aims at fostering inbound knowledge flows from other scientific fields into agricultural science, looking where work on co-design and co-innovation in agriculture can be further enhanced by cross-fertilization with concepts from management studies, design science, science and technology studies, and organization studies. The collection of papers presented in this special issue of *Agricultural Systems* contributes new conceptual perspectives and empirically-based insights to the emerging body of work on agricultural co-design and co-innovation, further outlined in the next section.

2. New perspectives on co-design and co-innovation in agriculture: the papers in the special issue

This special issue brings together different streams of research on co-design and co-innovation, including methods, tools and organizations. It offers empirical insights and theoretical advances to address a variety of issues (e.g., innovation ecosystems, collective design management, participatory design methods, system analysis tools and network management) that together shed new light on co-design and co-innovation in support of sustainable agriculture, thereby further opening perspectives and approaches.

The paper by Pigford et al. (2018) explores the complementarities between Agricultural Innovation Systems thinking and Innovation Ecosystem thinking which has roots in management studies, and suggests a more integrated approach to better understand and support transboundary ‘innovation niches’ for sustainability transitions in agriculture. Pigford et al. (2018) consider the extent to which innovation ecosystems thinking may help open the network of transboundary, inter-sectoral innovation niches in agricultural landscapes to realize more collective and integrated innovation in support of sustainability. They subsequently explore the potential utility of adopting an Agricultural Innovation Ecosystems approach to system design as a way to better emphasize the role of power in shaping innovation communities and their interaction with incumbent regimes; highlight the plurality of actors and actants in the landscape, including the integral role of ecological actants in innovation; and help cross scalar, paradigmatic or sector boundaries in order to engage with a variety of innovation systems affecting multifunctional agricultural landscapes and systems.

The paper by Berthet and Hickey (2018) focuses on the role of network managers to foster collective innovation aimed at enhancing the environmental sustainability of agriculture. They compare four empirical cases from Canada and France that were each identified as examples of successful collective innovation by public agriculture agencies, and analyze the roles of network managers in initiating and facilitating the interaction processes between actors (Connecting), guiding their interactions through process agreement (Framing), facilitating knowledge transfer and capitalization among the actors (Knowledge brokering) and searching for goal congruency by creating new content (Exploring) (Berthet and Hickey, 2018). The paper highlights the contribution of network managers through each of these broad functions and also identifies difficulties with building a shared vision among the network members and ensuring their long-term involvement in each case. In particular, they find that the Exploring task was mainly approached as a problem-solving process by the network managers in each case, where objectives were set at the outset, carried out by a core group of actors in the network, with farmers (in particular) being considered end-users. This result suggests a potential opportunity to enhance the skills of network managers in participatory design process management and creativity enhancement.

The paper by Prost et al. (2018) deals with the role of agronomists in facilitating participatory design processes involving farmers. Their research identifies that while traditionally agronomists have helped farmers to envision a ‘target’ agricultural system, there is also the potential for agronomists to support the involvement of farmers in both the design, implementation and monitoring of an innovation project using the case of improving water quality in a French region. Such a situation might renew the role of agronomists in agricultural systems and calls for new tools and modes of interaction with farmers. In their paper, a tool (referred to as a dashboard) was co-developed by agronomists and farmers to monitor the impacts of changes in agricultural practices and adjust them when deemed necessary. This tool was found to inform a dialogue between design intention and the way the situation “talked back” to the designers. This paper adds to the roles that innovation intermediaries may play in agricultural sustainability transitions over the long term, beyond initiating innovations.

The paper by Ditzler et al. (2018) operationalizes the concept of

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