Farmers' experiments and innovations: A debate on the role of creativity for fostering an innovative environment in farming systems

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Abstract

Innovation has become *the* promising concept to overcome problems and enhance agricultural performance in agricultural research and policies. In the past, innovation was mainly seen as being developed by science or enterprises, and only recently the focus has shifted from a linear to a systemic perception, acknowledging that innovation is a dynamic process that implies the participation of a diversity of stakeholders. Consequently the role of multiple stakeholders, including farmers, in the innovation process receives more attention. Farmers' experimentation is the process by which farmers informally conduct trials or tests that can result in innovations suitable for their specific conditions. Although the role of farmers experiments in the innovative process is increasingly acknowledged, literature on the creative process that leads to farmers' experiments and innovations is missing in farming systems research. The aim of our contribution is discussing this missing link, focusing on how motivations, learning processes and specificities of the workplace farm may influence the creativity of farmers.

1. Introduction: Farmers' experiments and innovations

The historical development of locally adapted farming systems worldwide can be ascribed to continuous experimentation activities of farmers (Hoffmann et al., 2007). Farmers' experimentation is the process by which farmers informally conduct trials or tests that can result in new knowledge and innovative management systems suitable for their specific agro-ecological, socio-cultural and economic conditions (Rajasekaran, 1999). Experimenting enables farmers to adapt to constantly changing conditions (Bentley, 2006; Darnhofer et al., 2010), is a means to generate local knowledge (Sumberg & Okali, 1997), and builds the base for countless agricultural innovations (Vogl et al., 2015). For a long time the term 'innovating' was mainly associated with science or enterprises and only recently the focus has shifted from a linear to a systemic perception on innovation, acknowledging that innovation is a dynamic social multi-stakeholder process that implies the participation of a diversity of stakeholders and institutions (Klerkx et al., 2012b), including farmers. Consequently the role of farmers as innovators and the value of local knowledge receives more attention (Brunori et al., 2013). Also, with the increasing interest in novel approaches to rural development including the concepts of participation and empowerment in sustainable rural development, the topic of farmers' experiments and innovations began to attract more attention (Bentley et al., 2010).

Innovation research has become a field of science covering a remarkable diversity of topics with a high complexity of theoretical and applied debates. One of the areas of research in innovation studies is agriculture where e.g. agricultural knowledge and innovation systems (Knierim et al., 2015) provide details on the process of innovating in the agriculture sector. In a claim for fundamental reorientation, systems redesign and radical innovations, Klerkx et al. (2012a) show the importance of visions, visual and tangible representations of novel agricultural system concepts in innovation and learning processes. Heterogeneous multi-actor environments with a variety of actors, sources, types and processes of active social learning are state of the art in learning and innovation networks for sustainable agriculture (Tisenkopfs et al., 2015).These environments enable co-learning and link grassroots experimentation of farmers with agricultural research and extension. These environments create a 'dialogue of wisdoms' (Tittonell et al., 2016).

Nevertheless, the creative process that leads to farmers' innovations is rarely studied nor described precisely in agricultural sciences and not yet taken fully into account in organic farming systems research (Vogl et al., 2015). As an example, in the organic farming literature, terms currently used for describing what leads to farmers innovations are e.g. 'problem solving', 'innovating' or 'self help' (TP-Organics, 2014). These terms are however used ambiguously and imprecisely, which might easily lead to ignoring the complexity of the processes involved. Both the organic farming and agroecology movement feature innovations (e.g. Herren et al., 2016) but miss carefully addressing the origins of innovations.

A lack of knowledge of this genuine creative process of 'innovating' might lead to ignoring the intervening factors, misplacing the key incentives and thus not sufficiently taking into account the opportunities for encouraging farmers' experiments and innovations. To our knowledge specific literature on the genuine process of creativity that leads to farmers' experiments and innovations is missing in agricultural sciences and farming systems research. Therefore, the aim of our contribution is discussing the link between creativity related research and farming systems research. We start by summarizing and defining relevant selected literature on creativity, motivation, learning and workplace influence, with specific focus on the potential relevance for farming systems research, farmers' experiments and innovations. After outlining and defining these concepts, we discuss options for creativity research in (organic) farming systems, with an additional focus on the specificity of the workplace 'farm'.

Creativity

Creativity is defined as the "development of a novel product, idea, or problem solution that is of value to the individual and/or the larger social group" (Hennessey & Amabile, 2010). Creativity can be found behind all innovations. Creativity is an attitude towards life that responds to problems in a fresh and novel way (Sternberg, 2012).

Creativity is being conceptualized in various models. We choose the Four-C Model, which distinguishes four levels of creative magnitude and development (Kaufman & Beghetto, 2009) in a way that will later allow to link these levels with examples from farming systems:

- mini-C creativity consisting of the creativity inherent in learning processes;
- little-C creativity consisting of amateur, everyday creative activities;
- pro-C creativity consisting of professional-level creativity;
- big-C creativity consisting of eminent creativity;

The investigation of creativity can be separated in the study of creativity of products and creativity of persons. When creativity is perceived in terms of products achieved, creativity is understood as largely situation-dependent and spontaneous. In opposite to this, creativity of persons rather perceives creativity as a stable and enduring trait of individuals (Hennessey & Amabile, 2010). Creative people habitually a) look for ways to see problems that other people don't, b) take risks that other people are afraid to take, c) have courage to defy the crowd and stand up for their novel beliefs, and d) seek to overcome obstacles and challenges (Sternberg, 2012).

Methodologically, the creativity of products can be evaluated by self-assessments (mini-C), consensual assessments from experts in the corresponding field (little-C, Pro-C) or major prizes or honours (Big-C) (Kaufman & Beghetto, 2009). The type of creative products achieved can be conceptualized as "contributions that accept current paradigms, contributions that reject current paradigms, and contributions that attempt to integrate multiple current paradigms" (Sternberg, 2006).

The study of creativity of persons on the other hand relies on experimental, case study or questionnaire-based research designs (Hennessey & Amabile, 2010). Creativity of persons depends on six distinct but interrelated resources: intellectual abilities (incl. seeing problems in new ways), knowledge (know enough about a field), a thinking style that gives preference to think in new ways, personality (incl. willingness to take sensible risks and overcome obstacles), environment (supportive and rewarding for creative ideas) and motivation (intrinsic, task-focused) (Sternberg, 2012).

Historically, the term creativity was approached from scholars from a variety of disciplines – including education, arts, economics, neurosciences, anthropology and diverse sub-disciplines of psychology such as cognitive, developmental, social, and organizational – all concentrating on very specific aspects of creativity. This resulted in a wide range of knowledge about creativity but also in fragmented and isolated groups of researchers losing sight of each other. Also, across all disciplines, creativity research has long concentrated on the creative individual or products obtained but largely neglected the creative environment in which creativity may or may not flourish (Hennessey & Amabile, 2010). Systems models were created to improve the understanding of creativity, and aimed for connecting (sub-)disciplines and increasing interdisciplinary investigation on creativity and for broadening the level of analysis to include the social and cultural environments in which creativity grows (Csikszentmihalyi, 2014; Hennessey, 2015).

Although systems views of creativity help to generate new insights and research questions, they may not adequately foster the application of these insights in real world settings (Hennessey & Watson, 2016). Since the ultimate goal of creativity research needs to be the promotion of creativity, a further focus of creativity research should lie on the application of findings in real world settings (Hennessey & Watson, 2016), such as schools, organizations, arts and, as our main concern, farming systems. For promoting creativity, e.g. in farming systems, a close look on motivation or motives is essential.

Motivation

Motivation is a frequently researched influential trait for creativity. To be motivated was defined as 'to be moved to do something' (Ryan & Deci, 2000). The types of motivation can be distinguished in intrinsic and extrinsic. Intrinsic motivation means behaviour that is inherently interesting and satisfying and thus results in positive feelings. Intrinsic motivation is enhanced by autonomy or

self-determination, feelings of competence and a sense of connectedness or relatedness to individuals, groups or societies (Ryan & Deci, 2000). Extrinsic motivation means to be moved to do something because a separable outcome is strived for, whereas the activity itself is not as satisfying (Deci & Ryan, 2008). Examples for extrinsic motivation include reward, expected evaluation, surveillance, competition or restricted choice.

Intrinsic motivation was found to enhance creativity (de Jesus et al., 2013; Hennessey & Amabile, 2010), whereas extrinsic motivators can reduce intrinsic motivation and creativity when self-determination is undermined. However, extrinsic motivation was also found to enhance creativity in some cases, such as rewards when people are already intrinsically motivated or when they confirm competence (Hennessey & Amabile, 2010).

Creativity may also, under certain conditions, be enhanced by prosocial motivation (Forgeard & Mecklenburg, 2013). Also mood states (Baas et al., 2008) and stressors (Byron et al., 2010) were linked with creativity. The links between motivation and creativity are thus pronounced but complex. Autonomy, competence and connectedness are key for enhancing intrinsic motivation, which again is important for enhanced creativity.

Both, creativity and motivation are key concepts used in research related to learning environments.

Learning

There are two premises regarding creativity in education: First, creativity can be developed, and second, all individuals have potential to be creative (Lin, 2011). Enhancing creativity has become a global-wide interest reflecting the demand to raise competitiveness, and so there is a trend to reform educational systems to equip young people with innovative and creative capacities. Consequently, creativity is regarded as a life capacity for future success (Lin, 2011). Sternberg (2008) defines success in his Theory of Successful Intelligence as the use of people's abilities, recognizing their strengths and correcting or compensating for their weaknesses, adapting to or shaping environments, and finding a balance in their use of analytical, creative and practical abilities (Sternberg, 2008).

Three interrelated elements are distinguished in creative pedagogy: Creative teaching (focusing on teacher practices), teaching for creativity (highlighting the learner agency), and creative learning (Lin, 2011). Torrance (1963) contrasted *learning creatively* with *learning by authority*: Children learn by authority when they are told what they should learn and accept ideas from authorities (e.g. teachers, books), whereas in the other process, children learn by means such as questioning, searching, manipulating, experimenting and playing (Torrance, 1963 in Lin 2011).

There exists a synergistic cycle among self-actualization, learning and creativity, but the fact that in the current educational systems we do not achieve excellence on a broad level indicates that there are significant challenges to entering and sustaining this cycle (Burleson, 2005). A way to enhance learning experiences is to let learners use their imagination and multiple points of view, by asking their own questions and seeking answers in diverse ways, in a process of developing and exchanging perspectives. Several important scientific discoveries were developed by imagination and the use of analogies, such as Einstein's Theory of Relativity or the discovery of the benzene-ring structure (Burleson, 2005).

One important barrier to learning is the fear of failure, although failures are critical to learning, and experts can be regarded as people who have failed many times. To overcome this barrier, the consequences of failure and humiliation should be minimal, motivation should outweigh failure, and learners should strengthen abilities to persevere through failure, such as motivation, will and effort. It can also be helpful when learners can reflect on their failures with experts and learn from the experts' experiences and strategies to deal with failures (Burleson, 2005).

Despite the abundance of research on creativity and learning, little achievements have been made to apply these research findings to the classroom or other real-world settings, except in the area of corporate creativity and innovation, with the aim to help companies boost profits (Hennessey & Watson, 2015).

There is a multitude of academic references on the importance of learning within agricultural systems and in natural resource management more general, including literature on social-ecological resilience. But when searching for concrete relations of learning and innovation with creativity, there is not much to be found. Most academic discussions circle around the question how to facilitate and enhance social learning (e.g. Blackmore, 2007; Hubert et al., 2012), how to enable learning and innovation networks (e.g. Moschitz et al., 2015), and adaptive (farm) management (e.g. Armitage et al., 2008; Darnhofer et al., 2010). Structural conditions hindering or facilitating innovation systems described in literature (Hermans et al., 2015) focus on (knowledge) infrastructure, laws and regulations, norms, values and culture, interactions, market structures, and finally capabilities of the involved actors – a point where creativity could be relevant.

Workplace

Much attention in scientific literature on innovation and creativity is given to topics related to characteristics of workplaces, performance of employees, behaviour of employers, architecture or interior design of office space and office buildings. The interest guiding research and development in these domains is often efficiency and effectivity of the performance of staff, the enabling environment for innovation but also how certain characteristics support or inhibit the creativity of the working process or products. Constraints and pressure in the work environment are detrimental for creativity. Speaking up about concerns, reporting mistakes, proposing new ideas, autonomy in the work or a degree of empowerment can be important for organizational creativity, like also team leader support, the behaviour of managers, time pressure or psychological safety (e.g.Hennessey & Amabile, 2010).

Compared to the vast, diverse and detailed literature on industrial or so called white collar workplaces, or on the workplace 'classroom' at schools or universities, the literature on the workplace 'agriculture' is relatively sparse. Conflicts based upon social processes between generations at farm level (Jaunecker et al., 2011; Larcher & Vogel, 2009), the ergonomics or safety of work in agriculture or forestry (Kogler et al., 2016) are just two examples of topics that are discussed. The debate on creativity in agriculture, forestry, gardening or other related professions that manage natural resources is seemingly inexistent.

Options for creativity research in (organic) farming systems

When we look into farming systems, innovation has become *the* promising concept to overcome problems and enhance agricultural performance. In the European Union Common Agricultural

Policy there is a clear shift from innovations originating from state and corporate Research and Development activities towards participatory innovations, which depend on individuals' or rural societies' own creativity. Innovations should consequently be developed in collective and creative learning processes (EU-SCAR, 2012).

Trying, testing or experimenting at farm level is one of the inherent processes of farming that contributes to explaining how the process of innovation is approached by farmers (Vogl et al., 2015), but the research on farmers' experiments has so far not explained sufficiently how and why individuals become experimenters. The scientific debate on creativity may help as it has not yet been extended to farming systems research.

Farmers and gardeners are immersed in a workplace that can be analysed related to creativity of products and/or creativity of processes. Interpreting Kaufman and Beghetto (2009) we see:

- mini-C creativity consisting of the creativity inherent in learning processes at farm level for the farmer and the farming family, e.g. in continuous contacts with consumers, other farmers, as participant in training courses or when watching TV documentaries on farming practices;
- little-C creativity consisting of everyday creative activities such as finding spontaneous solutions when confronting problems, and simple trial-and-error experiments (repairing, adapting, substituting resources,…);
- pro-C creativity (professional level creativity), i.e. the constant adaptation of farming practices to seasonality, trends at the market, available labour at the farm, etc.;
- big-C creativity consisting of eminent creativity, that could be attributed to such personalities like Lady Eve Belfour, Hans Müller, Hans Rusch or Rudolph Steiner, who are seen as key persons to the development of organic farming.

At all these levels of creativity various and differing factors influence creativity, including motivation, learning and the workplace, and thus the innovative capacity of farmers. And for all these influencing factors a range of discussion points and questions emerge about their interaction with creativity. In the case of intrinsic motivation (consisting of autonomy, competence and connectedness) such questions include:

- How do current agricultural politics and market forces influence farmers' autonomy and self-determination?
- How do farmers' basic and advanced education, peer group interactions, product vending, consumer interaction, local community etc. promote or weaken feelings of competence?
- How can farmers' evaluation, such as in environmental or quality control systems, be shaped to confirm competence and increase intrinsic motivation rather than induce a sense of surveillance and thereby contribute to the opposite?
- How do family members, neighbours, peer farmers and the larger society value farmers' innovations and thus create a sense of connectedness?

One possible strategy to promote new, creative ideas and social learning for innovation is to integrate 'outsiders' into the existing agricultural innovation systems (Hermans et al., 2015), but for this to happen it needs brokerage and dialogue between members at the periphery (Ingram et al., 2014). Another entry point to enhance creative learning within agricultural systems is in the

agricultural education system, be it on university level (Francis et al., 2012; Salomonsson et al., 2008) or on the level of agricultural schools, and extension (Francis & Carter, 2001). This leads us to the question how different learning environments and workplaces influence creativity.

If we aim at studying e.g. motivation and its impact on creativity at farm level, the concept of 'the workplace farm' might be too general. Work at farms includes often, like e.g. at diverse organic family farms:

- a series of different tasks with complex job descriptions, different from one to the other task, like managing the farm forest, arable crops, horticulture crops, farm animals for commercial purposes or for subsistence, maintenance and repair of machinery, household, administrative tasks or social networks, etc.;
- a diversity of actors involved, like family members of different age and sex, neighbours and friends that support the farm to a varying degree of intensity with a variety of complementary skills, hired labour, etc.;
- a managed mosaic of buildings, plots, and other units of the farming operation;
- an environment of seasonality, shocks and trends.

The impact of intrinsic or extrinsic motivation on creativity might be easily tested at the workplace agriculture and support a better understanding of the factors that support creativity, experiments and innovations at farm level. But these factors might depend heavily on the various multifaceted sub-workplaces and actors involved. There is not 'the (proto-) typical workplace farm' but e.g. the son's work in the forest or the mother's work in the greenhouse or the father's work on any other task that might have totally different enabling or inhibiting environments for creativity and thus the innovation capacity of the farm.

Farmers and their workplaces are embedded in what e.g. Hennessey (2015) calls the myriad of environmental factors or the creative milieu with strong impact on the intrinsic or extrinsic motivation. "For each of us, when prompted by just the right amount of novelty, feelings of competence, and sense of control, the inner state of intrinsic motivation sets the stage for prolonged periods of concentration, deep learning and the possibility of creative performance" (Hennessey, 2015, p. 196). Contrary, a variety of environmental constraints imposed by (or on) work place managers can have especially damaging effect on an individual's intrinsic task motivation and subsequent creativity performance. The environmental constraints may be cultural values, expectations, and associated practices by entire nations, regions or groups, as well as the culture of specific institutions and environments (Hennessey, 2015).

On these topics, more detailed research is needed in the context of farming systems. Especially the context of formal and informal institutions, like e.g. the tight regulations for organic farming at European level, and in many countries also at national or provincial level, paired with private schemes for organic farming might have an impact on creativity and innovation not yet explored sufficiently. Agricultural policy may have neglected the impact of its instruments, like rules and regulations, on risk taking, experimentation and collabouration, i.e., the motivation and creativity of farmers, and therefore on the capacity of the so much appreciated innovation partnerships.

The evaluation of work including the way how this evaluation is delivered, has a strong impact on creativity (Hennessey & Amabile, 2010). This evaluation of the farmers' work expressed in e.g. inspections or controls of a variety of institutions is a frequent phenomenon at farms (Vogl & Axmann, 2016). As one example, we conclude that e.g. organic farming inspection, the social and

technical skills of the inspector as well the way how the inspection and certification are delivered by the inspector and the certification body may have, together with the communication on the goals of the regulatory framework, intense impact on creativity at farm level and the innovative capacity of actors along the supply chain.

It will be important to pick up the insights on the relation between creativity and learning, e.g. for answering the question on how to facilitate creative learning processes that lead to creativity, farmers experimenting and relevant innovations for a sustainable future of farming.

We invite the audience to an open access assessment and debate on this paper, for contributing complementary insights and adding related references at www.researchgate.org, where this paper will be online at the pages of the authors.

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