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ENABLING LEARNING IN DEMONSTRATION FARMS: A LITERATURE REVIEW

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A B S T R A C T

Demonstration farms have a long tradition and have proved to be an effective means of supporting farmers in problem solving at the farm level. The new demands of complex and uncertain agricultural systems call for a renewed understanding of the approaches used and the concepts that underpin them, in particular those relating to farmer learning in the demonstration. A multi-faceted demonstration 'learning system' creates different contexts or conditions that enable learning. Of these contexts and conditions, structural and functional characteristics provide a good framework for analysis. This review paper aims to identify the key functional characteristics that enable learning in demonstrations. The paper provides a narrative review which presents, and builds on, the state of the art with respect to the main topic – enabling learning in demonstration farms. It draws on a wide body of literature, firstly with respect to theoretical insights into different forms of learning (single and double loop) and social learning processes, and secondly with respect to the factors that enable learning at programme level (e.g. strategies and approaches) and at farm and event level (e.g. mediation techniques). In doing this, it provides the building blocks for analysing the functional characteristics relevant to enabling learning in demonstrations. It concludes by drawing out the links between the demonstration objective, the functional characteristics and different forms and processes of learning. This work is taken from work in the EU H2020 project AgriDemo-F2F project and complements two other papers in this Special issue which examine the structural enabling environment and the cognitive processes of farm level peer-peer learning. An increased understanding of how learning through demonstration can be enabled in an increasingly complex context will help to develop institutions and programmes that aim to foster innovation in sustainable agriculture.

Keywords: Demonstration, farmer learning, structural characteristics, functional characteristics, AgriDemo-F2F project

INTRODUCTION

Demonstration farms have a long tradition, and have proved to be effective means of addressing problems and testing solutions at the farm level (Angell *et al*., 2004; Bailey *et al.,* 2006). Providing, as they do, the opportunity for farmers to: discuss issues with both peers and experts, jointly solve problems, monitor experiments, observe and compare practices in similar contexts to their own, as well as experience hands-on activities, they are well placed to foster learning and behavioural change. As such, they have become an established component of a number of advisory and extension systems and provide the blueprint for a number of different on-farm group learning formats (Vanclay, 2004; Coutts, 2005). Demonstrations, however, are having to operate in an increasing complex and diverse arena of new policy and commercial imperatives, volatile costs and markets, changing farm structure, technological innovations and ICT advancements, and fragmented agricultural knowledge systems. Furthermore they are situated within, and are not independent of, a wider advisory landscape and AKIS in which innovation is considered the result of a process of networking and interactive learning among a heterogeneous set of actors, such as farmers, input

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industries, processors, traders, researchers, extensionists, government official, and civil society organizations (Hall *et al.,* 2006; EU, 2012). As a result, demonstrations are funded, initiated, coordinated and delivered by multiple actors and arrangements (programmes, networks etc) who are active at different spatial and temporal scales, and aim to achieve a range of objectives.

These new demands and contexts call for a renewed understanding of the approaches used and the concepts that underpin them, in particular those relating to farmer learning, in the demonstration. There is a good understanding of the multiple elements that contribute to the process of learning and acquiring knowledge in the farming context (Millar and Curtis; 1997; Kilpatrick & Johns., 2003; Vanclay, 2004; Leeuwis, 2004), and of the different forms and levels of farmer learning taking place (Eshuis & Stuiver, 2005; Coudel *et al.,* 2011; Sewell *et al.,* 2014), and the adult cognitive learning processes active at the farm level (Percy, 2005; Duveskog *et al.,* 2012). However, our understanding of learning in demonstrations is less well developed, and there has been little analysis of how such learning might be enabled through appropriate structures (actors, networks, governance arrangements) and functions (processes and practices that support learning).

This review paper aims to identify the key functional characteristics that enable learning in demonstrations. It is taken from work in the EU H2020 project AgriDemo-F2F project and complements two other papers in this Special Issue which examine the structural enabling environment (Pappa *et al.,* this Special Issue) and the cognitive processes of farm level peer-peer learning (Cooreman *et al.,* this Special Issue) respectively. Collectively these contribute to the project's analytical framework. An increased understanding of how learning through demonstration can be enabled in a complex context will help to develop institutions and programmes that aim to foster innovation in sustainable agriculture.

METHODOLOGY

The paper provides a narrative review which presents, and builds on, the state of the art with respect to the main topic – enabling learning in demonstration farms. It draws on a wide body of literature which covers farmer learning, firstly with respect to theoretical insights, and secondly with respect to effective demonstration programmes and activities. In doing this, it provides the building blocks for the project's analytical framework in terms of the relevant functional characteristics[1].

Following a short section that defines demonstrations, three main sections are presented. The first describes the importance of context and sets out the rational for a framework of structural and functional characteristics for understanding the enabling environment for learning. The next section provides theoretical insights into different forms of learning and social learning processes, and discusses how these might be fostered. The next section examines how learning can be enabled in demonstrations, looking first at functional characteristics related to learning at programme level (e.g. approaches and strategies) and then at farm and activity (event) level (e.g. communication, mediation techniques). A section summarising enabling functional characteristics is followed by a conclusion.

RESULTS AND DISCUSSION

Demonstrations

As discussed above demonstrations can be thought of as operating at multiple levels in complex systems. Although there will be diverse goals, attributes, actors, networks and functions in each level, in very general terms, goals are often established at an organisational (public or private) level and then operationalized through individual or networks of demonstration farms and activities (events) using appropriate demonstration activities (hosts, facilitation, techniques).

A demonstration activity (or event) can be defined as: the diverse means for providing farmers with "an explanation, display, illustration, or experiment showing how something works" (Collins English Dictionary)[2] that can be subsequently applied in their own farming practices to bring about positive changes on their farm. These take place on demonstration farms, meeting places where dissemination of knowledge and information occurs, advice is provided, solutions and tools are designed and implemented as well as

[1] It was not the intention to conduct an exhaustive literature review. A preliminary literature search using search terms (Science Direct, Google Scholar) "farm demonstration" AND "learning" returned very few results in the academic literature (1990-present).

[2] https://www.collinsdictionary.com/dictionary/english/demonstration

controlled and on farm research is conducted (Kiełbasa & Kania, 2015). Demonstration farms can (but not always) operate or collaborate within a programme/network or project, an entity which organises, connects, coordinates or utilises demonstration farms and activities according to their own objectives. These can include formal or informal social networks which have been found to be effective in delivering demonstrations (Creaney *et al.,* 2015). Within these levels the objectives, actors, nature of the demonstration vary and can range from formalised regular events at formal long term experimental farms, to one-off industry or farmer organised events, to group facilitation and discussion around different farms (e.g. monitor farms, farmer field labs). They are planned around achieving a different outcome for: agronomy, animal husbandry, farm business, farm diversification, compliance with regulations, and good farm practice, and sustainability, to name a few, and coordinated and delivered by actors such as farmers, advisers, facilitators, technical experts, researchers, industry actors. Thus, one would expect such arrangements to compound the complexity of learning and adoption processes (Hill *et al.,* 2017).

Enabling learning- the importance of context-a framework for structural and functional analysis

This multi-faceted 'learning system' creates different contexts or conditions for learning[3]. As noted by others, agriculture and farming need to adapt to these more "loosely structured environments"(Coudel *et al.,* 2011). In such conditions learning is not simply a question of agency but also of enabling structures. According to Giddens (1984)[4] agency is determined by the structural properties of social systems, arguably therefore resources and competences that an actor or organisation has, and institutional features and structures (i.e. their institutional environments), all enable learning .This is the basis of theoretical perspectives that incorporate the situational or contextual elements of learning (e.g. Wenger, 1998; King & Jiggins, 2002). It is also captured in the AIS framework which describes the macro level structures and drivers (institutions, market etc) that determine innovation and learning; and in the AKIS framework which describes the linkage between actors and organisations, often with a view to how learning in networks can be fostered or facilitated (Hermans *et al.,* 2017). In line with this, the innovation systems perspective, Hekkert (2007) proposed structural and functional analysis to identify the determinants of technological innovations and to assess how well an innovation system is functioning. The structural components are the presence of actors, networks and institutions, actors' capabilities or institutional capacities while the functional components of the innovation systems include the knowledge development activities. Although developed to describe technological innovation, the notion of structural and functional analysis is particularly suited to understanding the demonstration context. In the literature concerning the effectiveness of on-farm demonstrations in achieving learning, a wide range of interrelated structural and functional characteristics are identified which enable farmer learning. The structural characteristics differ according to the actors involved, and their roles; the institutions, organisations, and network structures and governance and resources available; as well as the characteristics related to the demonstration farm (geographic location, accessibility) and to the intended audience.

Functional characteristics are related to demonstration activities (at programme and farm level), functions and processes which determine the practices developed to support learning, and include many different aspects: from coordinating effective recruitment, developing appropriate interaction approaches and conducting appropriate demonstration processes to enable and facilitate learning; and using diverse mediation techniques, tools and follow up activities. Using this we propose a framework (see Cooreman *et al.,* this Special Issue) which embeds the analysis of peer-peer learning within the context of interacting structural and functional components (Figure 1). This framework allows the relationship between learning at the farm demonstration level and the wider enabling

[3] Learning can be defined as the process of acquiring knowledge or skills through study, experience, or being taught (Prager & Creaney, 2017)

[4] This relationship between actors' agency and social structure is described in Giddens' (1984) structuration theory where actors are embedded in and operate within the determinants of their environment. Giddens theory implies that there is a reflexive relationship between actors and their institutional environment, in which actors are conditioned by their environment, but they also adapt to and change their environment.

environment to be studied. This paper reviews selected functional characteristics which enable farmer learning at the farm demonstration level, while Pappa *et al.* (this Special Issue) review the structural characteristics.

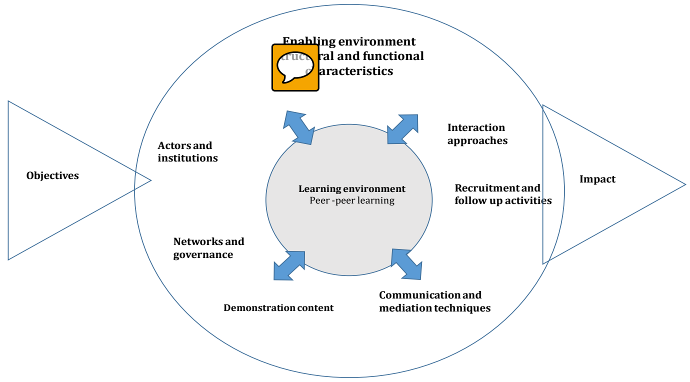

Figure 1. An analytical framework that embeds the analysis of peer-peer learning within the context of interacting structural and functional components.

Enabling learning: theoretical insights

The importance of context: Currently, there is no one theory or concept of learning which covers all the potential learning processes in demonstration, nor addresses all levels of learning. There is a large body of literature on knowledge, knowing and learning that is relevant to demonstration from different contexts: agriculture (e.g King and Jiggins, 2002; Schneider *et al.,* 2009; Lankester, 2013), knowledge transfer (Joshi *et al.,* 2007); technology and innovation (Hoogma *et al.,* 2002), natural resource management (Keen et al., 2005; Blackmore, 2007; Medema *et al.,* 2014), education (Kolb, 1984; Percy, 2005), learning economy (Lundvall & Johnson, 1994); communities and social movements (Wenger, 1998); organisations (Argyris & Schön, 1996). As Blackmore (2007:2) observes "There are many theories about what enables us to know or to develop knowledge. There is also a wide range of ideas coming from many different disciplines, about what constitutes learning". It is not the intention to review these ideas here but to identify aspects relevant to enabling learning in the demonstration context.

In agriculture, multiple elements contribute both to the process of learning and to the contextual factors that enable this learning (Coudel *et al.,* 2011; Leeuwis, 2004). Medema *et al.,* (2014), for example, identified content factors, context factors (external and internal), process factors and individual attributes as key drivers and conditions that facilitate multi-loop social learning; while, from a different perspective, Lankester (2013) described the many components that influence the who, what, and why of individual learning. Others confirm the social and contextual nature of learning, which has also been observed for the process of a farmer adopting a new technology or practice which is influenced not only by the characteristics of the farmer and the innovation, but also by the broader social environment (Pannell *et al.,* 2006; O'Kane *et al.,* 2008). Aligned to this are notions of learning as a continual and integrated psychological and social process of knowledge creation rather than a fixed process focused on outcomes (Lankester, 2013).

Different forms of learning: Learning processes are steered by the overall objectives and subject of the programme or intervention. This can be a new technology, innovation, novelty or artefact (e.g. a machine, a seed, a database) or a strategy (the ways an agent responds to its surroundings and pursues its goals), or a combination of both (Douthwaite et al., 2009). While some technologies or innovations require incremental learning, learning about concepts such as sustainability requires changes in values, representations (Keen *et al.,* 2005), goals (Lankester, 2013), or even skills. Each of these changes will demand different learning approaches, and different mediation approaches and techniques.

From the point of view of enabling learning to achieve objectives, there is a need to examine and understand the nature of the different forms of learning. From one perspective learning is fundamentally about achieving individual short-term change, specifically the "act or process by which behavioural change, knowledge, skills, and attitudes are acquired" (Knowles *et al.,* 1998). In the agriculture context this is often achieved by providing information through different formats to help farmer improve management practices and increase productivity and profitability. From other perspectives learning is more about building capacity, putting in place the capacities for learning, this can be at an individual or group level. With respect to individuals this can be in terms of providing triggers for change, improving analytical skills, critical thinking, the ability to make better decisions, and familiarity with practices; while at a group level it can happen by formulating networks and exposing participants to debate and others' ideas (Waddington *et al.,* 2014). At this deeper level, empowerment and enhanced capacity to learn are seen as indicative of improved and more transformative learning[5] (Percy, 2005; Duveskog *et al.,* 2011).

This capacity building is said to strengthen confidence and farmers' self-reliance, build community conscience, activate social life, and build social capital. The challenge of sustainability is seen as requiring at least this sort of 'second-order' social learning (Röling, 2002) or adaptive learning (Darnhofer *et al.,* 2010). However, providing the 'audience', such as demonstration participants, with both the means for incremental learning as well as the capacity to change are important, particularly as "an individual's decision about an innovation is not an instantaneous act. Rather, it is a process that occurs over time and consists of a series of different actions and experiences" (Rogers, 2003: 169).

The differences in the nature of the learning can be described in terms of the concept of learning loops originally developed by Argyris & Schön (1996) to explain the types of learning that characterise changes in group routines in collaborative contexts. Single loop learning[6] is understood as changing the way of working within a set frame of thought through incremental learning. Single-loop learning can be described as 'following the rules' while correcting errors by changing routine behaviour. This type of (incremental) learning can also be referred to as learning new skills and capabilities through incremental improvement, doing something better without examining or challenging underlying beliefs and assumptions. Double-loop learning refers to learning that alters underlying values, rules, and assumptions. In double-loop learning, individuals and groups reflect, not only on whether deviations have occurred and how to correct them, but also on whether the 'rules' should be changed. Double-loop learning occurs by fundamentally revisiting and reshaping underlying assumptions and patterns of thinking and behavior (reframing) (Coudel *et al.,* 2011; Medema *et al.,* 2014). Another level of triple-loop learning has been added to explain the learning dynamics that occur when a new collective structure emerges within a changing environment. This emphasises reflection and 'learning to learn' and is aligned to transformative learning impacts which entail a deep-seated shift in perspective (King & Jiggins, 2002).

Although Argyris & Schon (1996) consider that single-loop is developed through exchanges among a few individuals within a group, for double-loop learning to occur, a stable organisation must exist, while triple-loop learning mainly applies to organisations in constant motion. However, these ideas have been applied to individuals or groups, furthermore, rather than a rigid schema, commentators have noted that there is an intertwining of single-, double- and triple-loop, and this makes this concept suited to understanding learning (of all actors) in the multi facted demonstration arena.

Learning loops have been applied to natural resource management, adaptation and farming contexts (Duveskog *et al.,* 2011; Coudel *et al*., 2011), and correspond to other theoretical descriptions. Toillier *et al.* (2014), for example, identify three types of changes as an outcome of farmer learning. The first is a change in agricultural practices, without impact on the overall functioning of the farm. The second is a systemic change corresponding to a change in the farmer's objectives and his/her routines of organising productive activities. The third change is of the farmer's 'frame of reference' itself, i.e., of all his/her representations and assumptions resulting from acquired experience and which orient perceptions of experiences to come, leading to what Mezirow (1991) calls transformative learning.

There is also correspondence with first- and second-order learning levels (Hoogma *et al.* 2000[7]; Blackmore,

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[5] Transformative learning theory is considered uniquely adult and as situated in human communication, where 'learning is understood as the process of using a prior interpretation to construct a new or revised interpretation of the meaning of one's experience in order to guide future action' (Mezirow, 1996: 162).

[6] Zero'-loop learning can be achieved simply by a transfer between two individuals.

[7] In the transition/innovation literature Hoogma et al. (2000:58) distinguishes between first and second order learning: "First-order learning refers to learning about the effectiveness of a certain technology to achieve a

2007); and with the levels of reflection in Kolb's notion of experiential learning in which he defined learning as: "the transformation of experience into knowledge" (Kolb, 1984: 47). This sees reflection and the handling of information as explicit components of a learning cycle. In the same way Darnhofer *et al.* (2010) point out that in adaptive learning, quantitative information is often less important than understanding the 'rules of the game' and how these rules change. Monitoring through feedback systems allows farmers to learn about the options available in their context, and therefore actively adapt their farm management. They point out that, due to the uncertainty and unpredictable nature and the variable farming contexts, there are no single solutions, and argue that "Learning is thus not seen as an objective attempt to understand the 'world out there', but as based on a relational understanding of reality: learning allows for a new perspective of challenges and for perceiving new possibilities" (p549). To increase the number of learning opportunities and to structure them, it is useful to experiment and monitor the outcomes, as this allows widening the repertoire of options in case of changes in the context.

These insights are relevant to demonstrations in terms of the desired outcome. Where the objective is to provide information on a particular innovation a single demonstration event for example, this act of acquiring knowledge can be described as single-loop learning. If the objective is to build capacity, or to impart information about sustainability which requires some reframing as part of second-order or double-loop learning, then this demands a longer term programme of activities (events) to enable reflection and reassessment of values and assumptions.

Interactive social learning: Learning theories tend to take an individual-centric or social learning perspective depending on their origin and application. Although theories are often modelled on individual learning with individuals as the primary learner, particularly those from education which examine adult cognitive processes, learning is regarded as an individualised-social process in recognition that the social context is important (Lankester, 2013).

Since demonstration activities foster discussions and group interaction they are well placed to bring about shared learning. When individuals develop these shared understandings of a problem, this is characteristic of social learning. Social learning can involve different perspectives of a situation that move to shared perspectives, which are then used to address a problem (Röling, 2002). Social learning advocates an interactive (participatory) style of problem solving with outside intervention taking the form of facilitation (Leeuwis & Pyburn, 2002). There are multiple definitions of social learning which relate to adaptive management, dynamic processes of continuous sense making, experiential learning, feedback and monitoring, and stakeholder resolution of problems (Blackmore, 2007; Darnhofer *et al.,* 2010). King & Jiggins (2002) point out that the mutual premise is the need for facilitating this social learning in a purposeful and systematic way in the context of managing the change process in complex environments. This has significance for the effective coordinating of demonstration programmes, activities (events).

Perspectives that relate to social, collaborative and inter-personal learning are particularly relevant to demonstrations as these are practiced in an interactive setting. Collaborative and participatory learning experiences that develop trust, encourage dialogue and prompt individuals to critically reflect on assumptions of the world are an important part of learning, and in particular learning that enhances sustainability (Darnhofer *et al.,* 2010). Interactive learning also helps understanding of the combination of scientific knowledge and practical experience often necessary for success in a demonstration project. Indeed a key role of demonstration farms is as a fora for combining different types of knowledge, e.g. experiential and experimental knowledge from different actors.

In situated learning theories, Wenger (1998) stresses the importance of activity as well as of the appreciation of the local understanding of practitioners. They offer an understanding of learning as a collective experience with activity (not the individual) being the unit of analysis. Collective learning often as Communities of Practice relies on the ability of people to share their concepts of activity. These processes of collective problem solving are described by Leeuwis (2004) as active learning.

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specific goal. First-order learning aims to verify pre-defined goals, to reach goals within a given set of norms and rules. Second-order learning refers to learning about underlying norms and assumptions and is about questioning these norms or changing the rules" (cited in Raven, 2005:42).

These theoretical insights are relevant to understanding learning in demonstrations at all levels. Programme (or organisational level) and a demonstration farm/ activity (event) level learning are distinguished in the next section. For each level, selected functional characteristics are presented. At the programme level the focus is on the overarching approaches used to support learning and how they can incorporate user involvement; at the farm level the focus is on providing interactive spaces (using diverse mediation techniques, tools) for active learning with good facilitation.

Enabling learning in demonstrations

Enabling learning at programme level

Choosing an approach to suit the objectives: The overall approach to interaction adopted at the programme level is important in enabling learning in all the demonstration farms and activities. Here the term approach or strategy is used to describe the overall model used for the 'provider-user' relationship, advisory method and target group. Black (2000), for example, described linear 'top-down' transfer of technology; participatory 'bottom-up' or producer-led approaches or one to one advisory. Participatory approaches and methods have been associated with a number of benefits including higher rates of adoption and practice change; positive effects on yield, income and productivity; increased knowledge and skills associated with empowerment; and the availability of peer support (Coutts, 2005). However, whilst there has been a shift in practice towards more participatory network-led approaches in agricultural learning and innovation, top-down institution or industry driven approaches are still appropriate, where information about a scientific innovation or technology needs to be communicated or demonstrated (Black, 2000). This is as relevant to demonstration planning as to other forms of knowledge exchange.

A programme or organisation (public, private, NGO) providing advice may want to influence different kinds of decision making, such as adoption or management of a technology, a change in farming systems, collective decision making on resource use, or policy implementation (van den Ban, 2000). Ultimately the approach applied needs to suit the objectives or the purpose (and topics) of the demonstration activities run by the programme, and the intended audience. This, underpinned by the programme's overarching principles or philosophy, provides the rationale for the choice of approach. Discussing this, Leeuwis (2004:29) notes "communication for innovation can take many forms, not just in terms of the methods and techniques used, but also with regard to the wider intervention purpose, which relates closely to the assumed nature of the problematic". He identified different communication approaches or strategies (e.g. collective action bottom-up) referring to the way in which communicative intervention is supposed to contribute to problem solving. Here the distinction can be made in strategies between those fostering incremental change and adoption of discrete technologies as opposed to those supporting reflection and a change in values for a shift towards sustainability. However in practice the distinction might not so clear. For example participatory approaches can allow iteration and continuous reflection through progressive processes (e.g. creating awareness of new opportunities; deciding to adopt; adapting and changing practice; and learning and selecting) and are described as effective both for incremental learning about topics and capacity building (Douthwaite *et al.,* 2009). It is also noted that tensions may arise because the programme objectives might not be in line with those of the farmers, which can be exposed in participatory extension approaches (Prager & Creaney, 2017).

Leeuwis (2004) identified communication functions which are relevant within each of the strategies; functions like 'information provision', for example, can be relevant to all sorts of strategies. This is demonstrated in this definition of demonstrations, "[demonstration represents] the function of providing need- and demand-based knowledge in agronomic techniques and skills to rural communities in a systematic, participatory manner, with the objective of improving their production, income and (by implication) quality of life" (Haug, 1999). In this case there is a particular orientation towards productivity goals however the suggested means for achieving this are through demand-led participatory methods often associated with more diffuse and long term goals.

Building in processes for user involvement: Participatory, collaborative, and co-governance models that aim to empower farmers' engagement, may contribute significantly to effective demonstration programmes. This is in line with adult learning theories (Knowles, 1984), which recognise that adults need to be involved throughout the whole process of their instruction/learning. Involving farmers in the learning process, and making them accountable for their own learning, not forcing them to learn something, should foster a sense of ownership and autonomy. This proves very effective in adult education and links with motivation of the learner. In practice this means that the more the local farmers and institutions can be involved in the whole process of a demonstration, the greater will be their self-confidence and readiness to participate and learn. This is backed up by evidence from monitor farms in Scotland (Watson Consulting, 2014) where it was found that the social nature of repeated meetings contributed to participants becoming more likely to engage in networks, taking up leadership or representative roles, becoming more confident at speaking in public, being more willing to adopt new farming methods, and being more willing to share learning, information and practices with others.

Furthermore, with respect to learning, many of the principles of bottom-up approaches can benefit all forms of demonstrations, for example ensuring a degree of user involvement at every stage of the demonstration, including facilitating interaction with farmers during the design of demonstration, identifying co-designing experiments, etc. (Macey & Brown, 1990[8] ; Leeuwis, 2004). Thus, a crucial duty of the coordination or programme team, according to the literature, is to ensure an overall collaborating process across the demonstration programme. Close and regular cooperation and communication between different actors, e.g. in the form of a permanent cooperation calendar (meetings, seminars, etc.) can aid the overall programme effectiveness (Kiełbasa & Kania, 2015).

These insights about approaches and involving users highlight the importance of embedding agreed principles (e.g. collaborative principles) throughout the programme activities (planning, design, training, selection of facilitators and hosts, mediation techniques, evaluation). These decisions are fundamental to how the programme is operationalised at the farm and activity (event) level. For example, to gain full benefit from participatory approaches a long term plan (and funding) for repeated demonstration activities is required. In this respect there is notable link to both the goals and objectives and the structural characteristics of a demonstration programme since actors, networks and governance models are an essential component of shaping such a programme.

Involving users and having the means for joint reflection on how to correct deviations and on whether the 'rules' should be changed, can arguably enable single- and double-loop learning in demonstration programmes (individuals and groups). Opportunities to reflect and learn may also lead to triple- loop learning and allow for institutional changes, such as changes in structures, policies, programs, rules and decision-making procedure and fundamental changes in governance systems (Medema *et al.,* 2014). Structural changes will need to change correspondingly and in turn these will enable different forms of learning at the farm level.

Enabling learning at farm (and activity or event) level: At the demonstration farm (activity or event) level the approaches discussed above are operationalised as communication and mediation techniques and tools. These vary, they can include group facilitation, conventional teaching methods, benchmarking, visualisation etc. The principles behind these are reviewed here. The effect of different actors (demonstrators, participants etc), size of group, type of demonstration, regularity of events on learning in demonstrations is described by Pappa *et al*. (this Special Issue).

Providing a space for interactive learning: The extent to which demonstration activities enable peer-peer interaction, is seen as an important demonstration function. The significance of learning from other farmers through discussion, local networks, farmer-farmer ties, and peer-peer advice networks has been demonstrated in a number of studies (Isaac *et al.,* 2007; Baumgart-Getz *et al.,* 2012; Schneider *et al.,* 2009); and is highly relevant to demonstration farms and activities (events).

A key function of a demonstration activity (event) is to provide a positive and open learning environment, where farmers are able to ask questions, engage in

[8] Macey and Brown (1990, p234) referring to demonstration of energy technologies support this and list the following reasons for success or failure of demonstration projects: (1) user involvement is crucial at all stages of demonstration projects to facilitate information and learning, (2) project design should not be rigid to allow user input and modifications to improve effectiveness, (3) careful planning to take account of market readiness and user participation, (4) dissemination of results and evaluation information should be included in the project design

discussion and talk openly; the time/space for questions and probing; and the opportunity for participants to come up with their own conclusions and have opportunity to guide the learning agenda (Millar & Curtis, 1997).

Learning through negotiation, dialogue, debate, questioning and reflection are concepts that are relevant to peer-peer learning at demonstrations. Agricultural and contemporary educational theories support the view that social dialogue brings about learning, especially learning in which social interaction with more competent 'others' can be mediated through dialogue. Dialogue is not only a means of communication, but it is also a means to generate new ideas, negotiate understandings and build knowledge (Sewell *et al.,* 2014). This is supported by Keen *et al.* (2005) who argue that effective learning dialogues need to be processes that create the space and time for a range of different types of dialogue, in particular: a) disciplined debate b) interpersonal exchanges: smaller group meetings to build trust and a learning environment and c) creative dialogues: regular meetings with open agendas to nurture relationships. Previous research has shown that educational programmes similar to Farmer Field Schools, which engage participants pedagogically in direct learning experiences and encourage critical reflection on individual experience within the context of group dialogue, often foster transformative learning (Mezirow & Associates, 2009). Enabling these can provide both immediate learning opportunities (single-loop) but also allow reflection on values (double-loop) and help to build competences and capacity over time.

Aligned with this is the view that interaction should trigger reflections upon current circumstances, and an important feature of learning groups concerns the engagement among holders of different forms of knowledge allowing, in turn, for transformative learning. Hubert *et al.* (2012:180) argue that "creating a purposefully designed 'space' or 'platform' which brings together different views allows for the creation of synergies. "The value of bringing together different knowledges and combining local and expert knowledge has also been highlighted (Darnhofer, 2010). When these are opposing and conflicting, time is needed for a period of alignment and reflection to allow learning (Eshuis & Stuiver, 2005).

Enabling learning from experience and learning-by-doing (active learning): Fundamentally demonstrations are about providing information and evidence (thereby reducing uncertainty) about new practices and technologies, whether through experiment or example. A core part of this process is about providing practical experience to solve problems. Hoogma *et al.* (2002) point out that practical experience is necessary to generate knowledge required to accommodate introduction of new technologies – such knowledge needs to be tested in practice. Within the framework of participatory and demand-driven extension, hands-on practical learning in Farmer Field Schools emerged as a means of facilitating critical decision-making skills among farmers to deal with complex farming problems (Duveskog *et al.,* 2011).

A key function of a demonstration activity is to offer the opportunity to engage observers in the demonstration process. The pedagogical benefits of hands-on activities have been widely recognised elsewhere. The implications are that the ability of farm demonstrations to offer the time and space to be involved in such activities is key. With specific reference to farmer demonstrations, Millar & Curtis (1997) recognised how interactions between participants were most significant when practical activities were deployed. Hancock (1997) identifies a key function of extension activities as providing the opportunity for farmers to apply practices – the opportunity to do so enhances learning and understanding. La Grange *et al.* (2010) suggest that opportunities for farmers to be involved as, what they describe as, 'co-contributors' to the activities, reinforce learning outcomes. With respect to learning theories this aligns to the notion of active learning and learning-by-doing. The adoption literature also identifies the importance of observability and trialability which are relevant since demonstrations can provide the opportunity to trial, albeit by proxy, and observe (Rogers, 2003; Bailey *et al.,* 2006, Ndah *et al.* 2011). Again these processes provide both incremental learning opportunities but also allow reflection and help to build capacity over time. Some demonstrations, for example those on monitor farms, also provide the opportunity for benchmarking (Creany *et al.,* 2015). This experimenting and monitoring is a key dimension of adaptive learning according to Darnhofer *et al.* (2010) allowing reflection and continuous assessment.

With respect to other mediation techniques, Leeuwis (2004) also advocates the inclusion of visualisation techniques – particularly concerning issues that cannot easily be seen, e.g. pollution of ground water, to raise farmers' awareness of certain issues. In these instances, demonstration activities should look to methods that allow the visualisation of the problem, such as in field simulations, diagrams or mapping to foster discussions. The design of mediation and communication tools, such as farmer-presented instructional videos or farmer-written blogs can amplify the effectiveness of extension activities and confer a number of benefits. For example, Gandhi *et al.* (2009) recognise how the 'excitement' of appearing in participatory instructional videos motivated local farmers and their communities and reduced the 'distance' between farmers and the 'experts'.

Sewell *et al.* (2014) support this describing the value of designing multi-sensorial experiences in farmer learning activities (events) including walking, talking, listening, observing, tasting, smelling.

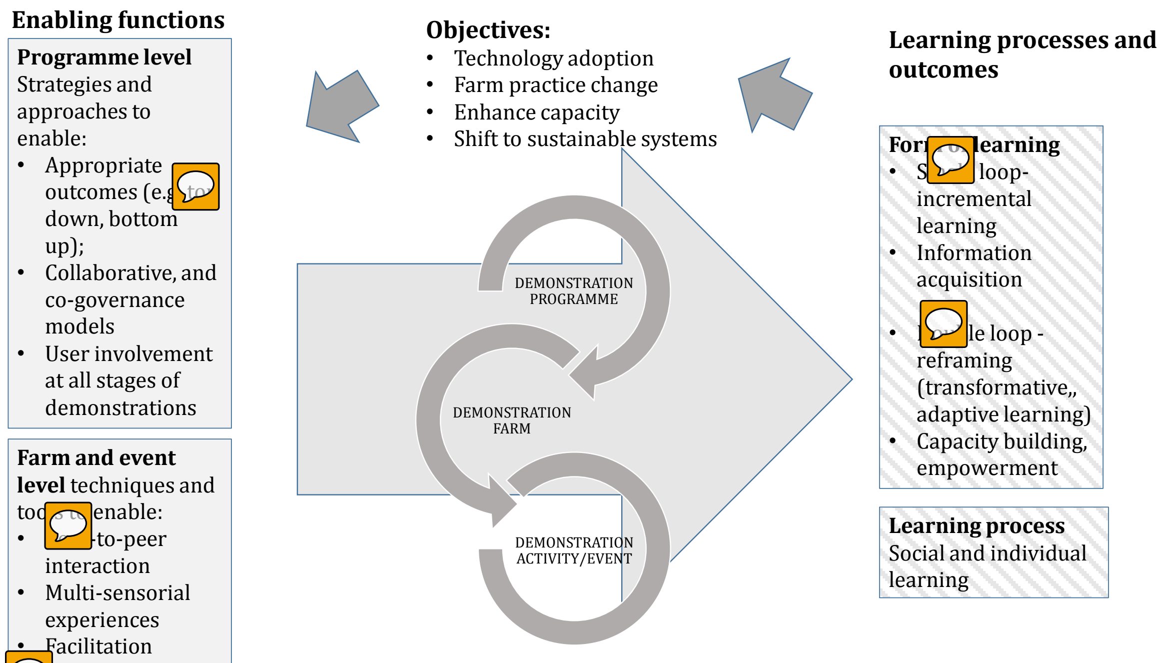

Figure 2. Linking objectives, enabling functional characteristics and forms of learning at programme, farm, and activity demonstration levels.

Mediating and facilitating interaction and learning: Ensuring effective mediation in the process of demonstration is important to enable learning (Gandhi *et al.,* 2009). A mediator can be an expert demonstrator or facilitator. As a demonstrator they should be good communicators, trusted, respected and credible, have local connections, understanding, and experience. If acting as expert advisers at demonstrations, a high level of specialist knowledge and progressivity of the adviser is required (Elmquist & Krysztoforski, 2015); they need to possess both experience and expertise (knowledgeable in the relevant field) (La Grange *et al.,* 2010).

Facilitators need different skills to help make groups perform more effectively. Outside intervention taking the form of facilitation is at the core of collaborative learning and problem solving (Leeuwis & Pyburn, 2002). Facilitation formalises and organises the learning environment and learning processes. It manages critical discussion among participants with the view that over time, deeper levels of understanding, inquiry, and innovation can be created; it thus enables effective learning. Compared to other actors (opinion leaders, champions, linking agents and change agents) facilitators' overarching role is to assist (individuals or groups) through the process of demonstrating a change in practice. Facilitators should foster active listening, learning and questioning by providing (confrontational) feedback, raising questions, stimulating people to talk, as well as translating and structuring information, and educating/training, depending on their remit (Leeuwis, 2004). The important link between facilitation and social learning has already been noted.

Taking account of the variation in farmers' learning capacities and contexts: Long (2004) recognises there is no such thing as a 'stereotypical' adult learner. Taking account of the variation in learning capacities and learning styles of individual farmers and their diversity of knowledge and skills is an important part of enabling learning (Millar & Curtis, 1997; La Grange *et al.,* 2010). Trigger factors, why the farmer is learning, the learning style, the nature and source of knowledge and the time span (Toillier *et al.,* 2014; Kilpatrick & Johns, 2003) are all important factors that need to be accommodated in demonstration activities.

Summarising enabling functional characteristics

The link between the demonstration objective, the functional characteristics and different forms and processes of learning is clear (Figure 2). Theoretical perspectives (hatched boxes) suggest that learning is a social process; and that it can be incremental (single-loop), or build capacity and lead to reframing of values (double-loop, transformative). Different approaches and techniques and tools at programme and farm (event) level (shaded boxes), devised to suit different objectives enable different forms of learning. For example, where a shift in values and frames is required, as for sustainability issues, demonstration programme design and development needs to consider longer term approaches that aim for to double-loop learning.

At the programme level enabling functional characteristics were identified as:

• the approach applied needs to suit the objectives or the purpose of the demonstration activities run by the programme, and the intended audience

• a degree of user involvement at every stage is required of the demonstration, including facilitating interaction with farmers during the design of demonstration

At the farm and activity (event) level enabling functional characteristics were identified as:

• providing interactive spaces (using diverse mediation techniques, tools) for active learning, engage in dialogue and discussion and talk openly; a positive and open learning environment, the time/space for questions and probing hands-on activities

• ensure effective mediation and facilitation of the process of demonstration

• take account of the variation in learning capacities and learning styles of individual farmers

CONCLUSION

The multi-faceted demonstration 'learning system' creates different contexts or conditions that enable learning. Of these contexts structural and functional components provide a good basis for analysis. The functional components and their effect on farmer learning were elaborated here. On a more general note, this paper opens up new perspectives on researching farmer learning in demonstration contexts, topics which have been previously been studied in a fragmented manner. Drawing on a range of theoretical ideas and empirical work, it develops different analytical lenses: structural and functional characteristics for enabling leaning, and different levels of learning: programme, or farm and activity (event) level. These new perspectives on learning are not only useful within the context of demonstrations but can effectively be used under different settings and foci in extension, innovation and adoption research more widely. The functional characteristics for enabling farmer learning identified in this review will now be used in the AgriDemo-F2F project, together with the structural characteristics, to analyse how learning is enabled occurs in different farm demonstrations across Europe.

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