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PLAID: A PRACTICE-BASED CONCEPTUAL FRAMEWORK AND TYPOLOGY

WP2 : Practice-based conceptual framework and typology development

PLAID
PEER-TO-PEER LEARNING:
ACCESSING INNOVATION
THROUGH DEMONSTRATION

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ABSTRACT

This PLAID practice-based conceptual framework and typology report establishes a conceptual framework for project team members to understand a number of key issues, namely: defining what a demonstration farm/activity is, how a typology can be constructed, how to assess demonstration success, the theory of behavioural change via demonstration, what we mean by sustainable agriculture, and how we can upscale from demonstration activities to wider change in the farming community. The document underpins the other work packages by exploring debates around key concepts and theoretical perspectives in order to ensure common understandings and assist with later analysis of the case studies (WP5) and Geo-referenced industry data (WP3). This is an inital working document that will be revised as empirical findings emerge and can contribute to our conceptual understandings of demonstration farms and activities (WP2, Task 2.4).

PLAID

TABLE OF CONTENTS

PLAID

1 Introduction: What is a conceptual framework and how can we use it in Plaid?

The development of a conceptual framework is an important stage in any research project as it creates a bridge between empirical work within a project and any theoretical assumptions that may underlie it (Malalgoda et al., 2016). While some studies present a conceptual framework as a single interlinked model showing the relationship between concepts and stages of the project a conceptual framework is generally not a model, but is a document that covers the key factors, constructs, variables, assumptions, laws and ideas that underlie a the broad concept of interest (Jabareen, 2009; Gurevitch et al., 2011). As such it presents the definitions, assumptions, beliefs and theories that are required to support and inform the research (Malalgoda et al., 2016). In this way, it is theoretically pluralistic, yet intended to "define connections and elements of knowledge in a general area of inquiry, giving coherence and direction to the study of empirical problems" (Gurevitch et al., 2011, 408).

Within the PLAID project the conceptual framework addresses a number of areas central to the empirical research questions where, while theoretical knowledge is unlikely to be developed, theory is nevertheless required either (a) develop a common and informed understanding of concepts and approaches, or (b) design instruments for conducting the empirical work in the study. This conceptual framework addresses the broad issue of how to understand and theorize learning in demonstration farms/activities for sustainable agriculture and how this learning may or may not lead to sustainable changes at individual farm level and the wider farming system. It covers a number of issues raised in the project description, namely:

Table 1 : Components of the conceptual framework and their objectives

Component of framework		Objective
1.	Introduction to the conceptual framework	To outline the purpose of conceptual framework
2.	The history and nature of demonstration farms/activities	To provide a common definition of demonstration farms/activities
3.	Developing a demonstration farm typology in Plaid	To provide a theoretically grounded basis for categorising farms in the Geo-referenced inventory and case studies
4.	Assessing demonstration success. A theoretical and methodological perspective	To provide research teams with an idea of effective learning methods and good knowledge transfer practices as the theoretical basis for developing the online database
5.	A theoretical perspective on behavioural change through demonstration	To provide research teams with a theoretical understanding how behaviour changes and can be changed, in order to assist in analysis of case studies
6.	Sustainable agriculture – the PLAID perspective	To provide researchers with a shared understanding of sustainable agriculture and methodology to assist in identifying degrees of sustainability focus in demonstration
7.	Beyond demonstration: upscaling form the Multi-Level Perspective	To provide a common theoretical understanding of how learning processes and learned knowledge can be transferred

	from farmers attending the demonstration to the wider community and create change at the regime level

In many cases these concepts will be able to be refined on the basis of empirical evidence gathered in the course of the study. It is therefore intended that the initial conceptual framework be updated as and when necessary in order to keep work packages up to date with current theoretical understandings. The final revised conceptual framework will be submitted in month 27 as D2.2.

2 The history and nature of demonstration farms/activities

2.1 History

The on-farm demonstration of agricultural improvements has been an important part of agriculture in Europe for at least the last two centuries. Prior to this, the conditions of roads were so poor (and the travelling dangerous) that any demonstration was either done locally (often by wealthy landowners) or was transmitted through reports in privately written books on farming. For example, William Ellis, a farmer from Little Gaddesden in Hertfordshire in the mid-1700s published many books – mostly in an anecdotal style concerning farms in the region. His 1743 publication "The Modern Husbandman for the month of October" (Ellis, 1743, 50) includes, amongst many other anecdotal accounts, a story concerning "A farmer, who lives so near a great common, about two miles distant form my house … seldom gets a good crop of grain" on which the author proceeds to detail the reason as poor use of fertilisers. Ellis's prolific writings created a great deal of interest in his farm across Europe. For example, a Swedish professor of natural history (Pehr Kalm) visited his farm in April 1748 for two weeks to learn his "ways of husbandry" and, on return to Sweden, transferred ideas about English agriculture through his teaching at Åbo (Mead, 2003) .

This informal (sometimes unwitting) type of demonstration farming was formalised in the latter part of the century through the establishment of "county societies" across Europe. By the 1770s there were reportedly over 30 county societies in France, several in Switzerland, and others in Leipzig, Wirtemberg, Hannover, Zurich, Heidelberg, Stockholm, and so on (Weston, 1773, iv). The primary objective of these societies was to improve the general condition of agriculture of the region through learning and then teaching neighbours by example (see, for example, The Journal of the Bath and West of England Society for the Encouragement of Agriculture, 1855, viii). Besides the new interest in scientific principles of agriculture, the importance of food security to the frequently waring nation states and empires of Europe contributed to the spread of agricultural knowledge (see Young, 1771) while the growing and industrialising cities of the time required more food than the then dominant peasant agriculture could provide.

The concept of formal demonstration farms (at that time termed "model" or "pattern" farms) emerged in the last decade of the 18th Century. For example, demonstration farms were located in Worcestershire in the United Kingdom (Pomeroy, 1794), in Sweden (Mease, 1818), at Moegelin in Brandenburg, Germany (Louden, 1825), across France (anon, 1845a), across the United Kingdom (anon, 1845b), and at Hofwyl in Switzerland (anon, 1818). These were predominantly private farms established by wealthy individuals or organisations (funded by subscription and occasionally with grants of land from the government) with the intent of improving agriculture and the economy within the country. An advertisement for a model farm at Whitfield near Thornbury in the United Kingdom (established in 1839) illustrates how the approach to farm demonstration shows many similarities with today's. It notes:

> "… the farm is open to the visits of any one; every operation performed on it is open to the inspection of all; and reports of its condition, and of the various steps in its progress towards an improved state of cultivation, are to be put forth at intervals." (Johnson & Shaw, 1842, 11)

The pattern farm at Hofwyl was claimed to be exceptionally effective, i.e.,

> "They saw also, in the pattern farm, the most perfect agriculture; and they spread throughout the country a knowledge and a taste for it." (anon, 1818, 57)

Such farms were not "experimental farms" which also existed at the time. The primary difference between the two was that experimental farms were for the performance of experiments and, as such, were neither intended to demonstrate best practice, nor to be profitable (The Committee appointed to consider the Petition of the Wester Ross Farming Society, 1841, p87). This distinction is still in evidence over 100 years later with some sources defining experimental farms as those used for experiments without regarding the overall condition of the farm, whereas demonstration farms demonstrate proven practices to promote optimum farm development (USDA, 1951). However, as the promoting of advanced and innovative practices generally requires some element of experimentation, this distinction is not a clear one. Reference has been made to hybrid "testing and demonstration" farm since the early 1900s (Bess, 2015), and AWC and WRO (2013) comment that while demonstration farms act as a demonstration site (chosen as an example of good practice) they are "usually run for experimental purposes" and that the two purposes are "not mutually exclusive" (also Kania & Kiełbasa, 2015).

Any outline of the entire history of demonstration activities throughout the 20th and early 21st centuries would be a long and, for our purposes, unnecessary task. The important issue to note is that the fundamentals of demonstration farming have been in place in Europe for more than two centuries and, in general, the principles behind demonstration farming have not altered significantly over that period.

2.2 Informal demonstration – looking over the fence

Underlying all demonstration agriculture is farmers' practice of observing neighbouring properties in order to learn what works for other farmers, what new technology is available, what diseases might be present and how they can be treated, and so on. The importance of "looking over the fence" has been observed in many studies of behavioural change in agriculture (e.g. Burton, 2004; Burton et al., 2008; Marshall, 2004; Cocklin et al., 2007; Tarnoczi & Berkes, 2010; Kenny, 2011; Bellotti and Rochecouste, 2014; Strand et al., 2014). Looking over the fence is an informal (or even unwitting) form of demonstration, but nevertheless one where probably the most significant amounts of locally relevant knowledge are transferred. For example, Kenny (2011) contends:

> "A consistent message is that farmers learn most by looking over the fence and seeing what their neighbours are doing." (Kenny, 2011)

Tarnoczi & Berkes (2010) similarly contend that social sources of information – transfer between neighbouring farmers – was the most widely observed source of information for farmer adaptation in their study of climate change adaptation.

It is the experimental and observable nature of the information transferred that makes this form of learning so important within the farming community. For example, Tarnoczi & Berkes (2010) note that farmers in their study claimed to me more wiling to try a new approach (conservation tillage) after seeing a neighbour succeed with the practice – even where they had learned about the practice previously. Bellotti and Rochecouste (2014)

similarly observe that seeing a neighbour succeed at a time of adversity – such as an intense climatic event or an economic downturn – can lead farmers to adopt new practices that they had knowledge of previously. This emphasises the critical role that this informal observation of and comparison with neighbours has in converting learned knowledge into behavioural change – and how knowledge transferred via demonstration can lie dormant until change is triggered by critical times in the development of the farm (e.g. Sutherland et al., 2012).

Informal demonstration activities such as these have been found to play an important role in transferring knowledge from both people who attend formal demonstration events to neighbouring farmers (Cocklin et al., 2007) and from proactive, innovative farmers to other farmers within the community (Kenny, 2011) – potentially creating a "domino effect" of adoption within a region (Marshall, 2004). In some cases farmers go beyond passive demonstration and establish informal property demonstrations in order to promote innovation within peer-to-peer networks (noted by Keuper et al., 2013).

Figure 1 : Transfer of innovation via informal links to wider farming community.

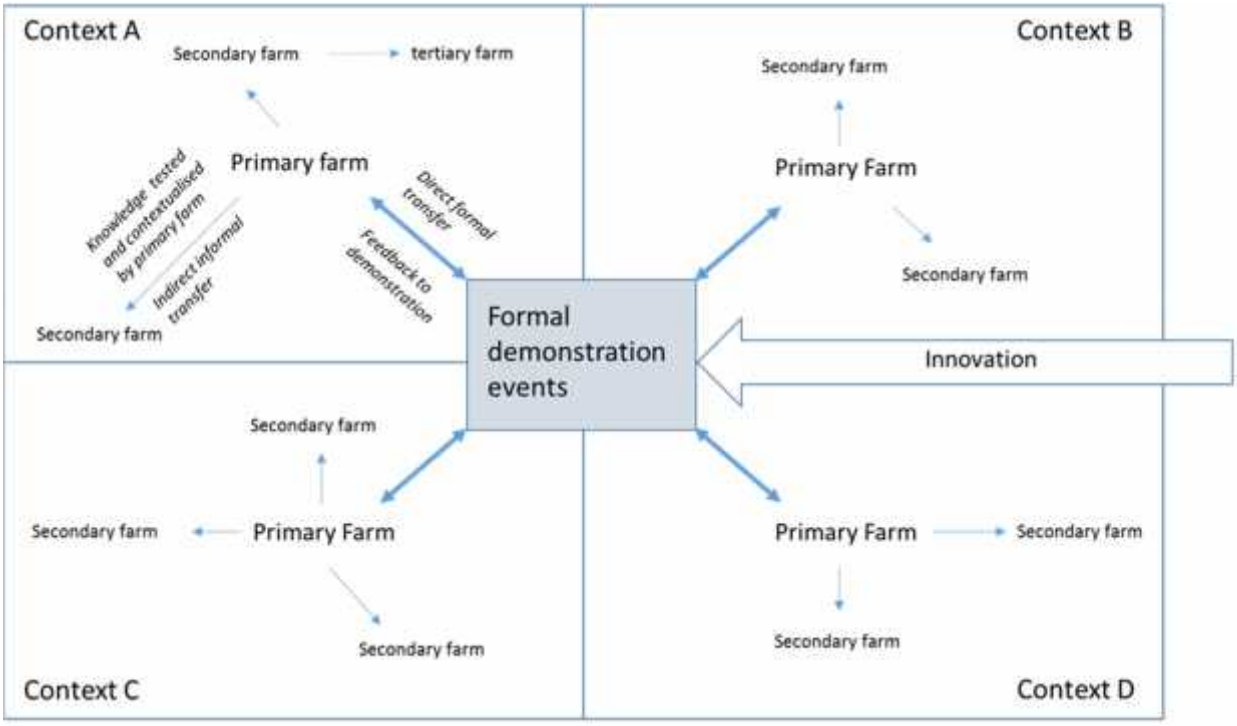


Figure 1 illustrates the concepts discussed above. Where demonstration events are formally organised knowledge is transferred to innovative farmers who attended the event where it may then be developed, contextualised and proved within a local context. Having proved its worth and, in many cases, being adapted for local environmental, social and economic contexts informal processes of knowledge transfer (looking over the fence) leads to other farmers within the same context adopting the innovation until eventually the innovation is transferred from the niche to the regime level. Taking the concept one step further, sociological studies and theoretical frameworks suggests that these structural and behavioural changes then become integrated culturally through becoming a "farming style" (van der Ploeg, 2003) or becoming recognised with the community as "good farming" practice (Burton, 2004) (see Section 6.4 for mechanisms) – making them self replicating and pervasive and embedding them as part of the local farming identity (e.g. Strand et al., 2014; Morton et al., 2017) .

2.3 Formalising the informal – Monitor farms

Although looking over the fence provides a key means of transferring information in farming communities, the informality of the processes means that substantial amounts of information may be missing – contributing to a delay in the innovation transfer process. In order to be able to access more information while, at the same time, retaining the key qualities of informal demonstration farming (i.e. the experimental and observable nature of the activity) monitor farms have become an important stepping stone between more formal demonstration processes and the farmers themselves. Developed in New Zealand in the early 1990s, monitor farms were an attempt to overcome an issue with standard development and demonstration programs, namely that

> "… the results of existing research were not getting across to people. The results were either not known, or people could not see how to apply them to their own situation (Rhodes & Aspin, 1993, 23).

In response, the Meat and Research Development Council funded 23 monitor farms to be managed by community groups consisting largely of farmers, researchers, veterinarians, financiers and fertiliser industry representatives (Baker and Associates, 1998). Hallam et al. (2012) observe that monitor farms are based on the premise of ongoing interaction with a defined group of farmers – which has the key advantages of demonstrating developments resulting from new innovations over time, as well as allowing monitoring and comparison in a familiar context. As the decisions are made by the farmers themselves the farms do not necessarily demonstrate "best practice" but provide an opportunity to assess the effects of innovation within a controlled and benchmarked environment (Hallam et al., 2012). The monitoring aspect is critical because, as Webby & Sheath (1991) observe "There is nothing worse to dampen the incentive to adapt if failure is recognised only at the end and there is no understanding or explanation as to why goals were not reached." Another key feature of monitor farms is that they are standard commercial farms that the farmer opens to a wider community group – enabling discussions to be held in a practical way (ADAS, 2008).

Initial attempts to establish monitor farms in the UK were problematic because of a key difference from the New Zealand approach. Whereas in New Zealand decisions on changes in management were made collectively by members of the community groups in the UK model they were used "as an instrument for the demonstration of technologies" and subsequent problems led Garforth et al. (2003, 331) to observe "the method will not necessarily work so effectively if it is used simply to demonstrate technologies which have been determined by someone outside the group." Monitor farms implemented in Scotland in the early 2000s follow the New Zealand model – being structured around a community group and focused on economic improvement (Dwyer et al., 2007). While the model in New Zealand (Baker and Associates, 1998) and Scotland (ADAS, 2008) have been successful in terms of commercial gains, the requirement for decisions to be made by the community group raises issues concerning how effective monitor farms are at contributing to non-financial objectives – such as environmental sustainability (Hallam et al., 2012).

2.4 Formal demonstration – Demonstration farms and activities

Perhaps surprisingly and despite extensive online searching, we could find no authoritative single source on demonstration farms available in the literature – leading to the conclusion that much remains to be done in terms of defining and describing the functioning of demonstration farms. The term "demonstration farm" emerged at the beginning of the 1900s and probably has its origins in the work of American Dr. Seaman A. Knapp who is credited (incorrectly) by some with the first use of the demonstration

method as a means of influencing the adoption of new farm practices (Kittrell, 1974). Knapp initially used the term "demonstration farm" to designate that proportion of the farm that was being managed explicitly according to the instructions of agents working for the Bureau of Plant Industry – with the "demonstration farm" being visited by agents once a month to ensure instructions were being followed and provide any additional advice required (Knapp, 1909). It was only at a later point that the term "demonstration farm" was used to refer to farms entirely managed under instruction (True, 1928). The object of a demonstration farm was:

> "to place a practical object lesson before the farm masses, illustrating the best and most profitable methods of producing the standard farm crops" (True, 1928, p154)

Knapp's approach to demonstration farms was thus to simply seed the landscape with farm fields that were being managed under efficient agronomic principles. He notes that demonstration farms had to be managed over an extended period because "the farmer is a natural doubter" (True, 1928, p156) and therefore evidence of improved yield may not be initially attributed to improved farming practices. However, he suggests that by the third year of demonstration the neighbours who have been observing the farm "have commenced to inquire and follow his example" (p156). Knapp (cited in Martin, 1921, p17) details how this process then leads to change:

> "His neighbours ask him how he produced it. He is invited to address public assemblies. He has become a man of note and a leader of the people and can not return to his old ways. Soon there is a body of such men; a township, a county and finally a state is transformed."

This is important because it illustrates how early demonstration farms were not as much centres for education, as for cultural change – embedding the new improved ways of production within the very identity of the farmer such that he "cannot return to his old ways" . Demonstration farms were thus engines for regime level social change (see Section 7).

Under this system Knapp also established field schools. These were not open to all farmers, but only to "co-operators" or, in other words, farmers "who agree to work a part or all of his crop according to our instructions" (Knapp, 1909, p154). For these field schools all co-operators in a vicinity were expected to meet on one demonstration farm to discuss methods and evaluate the outcomes of the work. The objective of field schools was to promote "direct public comparison and competition with other farmers" in order to overcome the problem that scattered demonstration farms often had no point of comparison other than agricultural fairs. Agricultural fairs, however, were not considered good arenas for comparison they involved only displaying the "best" of the produce, whereas the objective of demonstration farming was to improve average yields. Farmers from closer to the demonstration farms could be invited to attend when the field agent visited, a visit that Knapp contended would encourage the co-operator to further improve the quality of his/her production (Martin, 1921).

Knapp's focus on peer-to-peer learning and embedding of cultural change made the objectives of early demonstration farms far more ambitious than the earlier "pattern farms" which were predominantly simply experience-based learning centres. However, his emphasis on cultural level change and the focus on simply seeding change within farming communities differs somewhat from contemporary demonstration farm activities which have somewhat blended the concepts of pattern farms, experimental farms and "demonstration farms" into a more educationally based collective learning approach. Numerous studies refer to demonstration farms but there is a considerable variance in terms of the qualities ascribed to them. From the wide variation it is clear that the contemporary definition of a demonstration farm (i.e. what it is and what it does) is not fixed but varies considerably according depending on the organisation conducting the

demonstration. Thus the focused effort of Knapp and colleagues to create a new production culture has been relapsed by a more flexible system designed to attain a variety of specific objectives from the commercial to the environmental.

Nevertheless, reviewing the literature on demonstration farms however does enable three key features to be identified which are likely to be part of any demonstration farm.

The first key feature is the strong emphasis on experience-based learning as a means of knowledge transfer and promoting behavioural change. Demonstration farms are about seeing and discussing possible future innovations and how they work for other farmers (Leonard & Cobham, 1977; Bailey et al., 2006; Hallum et al., 2012; Elmquist & Krysztoforski, 2015), with discussions being both farmer to farmer and farmer to expert (Kittrell, 1974; Bailey et al., 2006; Elmquist & Krysztoforski, 2015; Kania & Kiełbasa, 2015). Consequently, demonstration farms are working farms that are able to demonstrate local suitability (Leonard & Cobham, 1977; Bailey et al., 2006; Hallum et al., 2012) with the demonstrations based on practical implementation (Kania & Kiełbasa, 2015).

Second, a number of researchers contend that demonstration farms enable innovations to be seen in a wider farm context and/or over an extended time period (Leonard & Cobham, 1977; Smallshire et al., 2004; Clark, 2010; AWC and WRO, 2013; Cook, 2014) including the provision of financial data to validate the financial success of the innovation (Leonard & Cobham, 1977; Pangborne et al., 2011).

Third, demonstration farms are focused on the demonstration of “best” or “good” practice (USDA, 1951; Kittrell, 1974; Smallshire et al., 2004; House of Commons, 2011; AWC and WRO, 2013; Elmquist & Krysztoforski, 2015). Although experiments may be conducted on the farm (e.g. Pangborne et al., 2011; Pangborne, 2012; Kudsk & Jensen, 2014; Kania & Kiełbasa, 2015) they are often for learning as much as for research purposes. Demonstration farms are predominantly for education (Kittrell, 1974) with – unlike for monitor farms – the object of the demonstration dependent on the objectives of the governance organisation (Elmquist & Krysztoforski, 2015).

By assembling these three components we can create a definition of “demonstration farms” for use within the Plaid project:

> Demonstration farms are educational centres for experience-based learning that promote the practical viability of new or improved farm management practices and technologies through seeing and discussing. They place a particular focus on understanding innovation within a working farm context, within a local setting and across the different stakeholder groups involved. While they focus on the demonstration of known “best” or “good” practices, experimental work may also be conducted, particularly in a learning-by-experiment context. The objectives of the demonstration farm are generally determined by the governance organisation rather than participant farmers.

In terms of the effectiveness of demonstration farms evidence of on-farm change by attendees has been identified in a number of studies. For example, in an evaluation of the “Forward Farming” demonstration activities, Bailey et al. (2006) found that 16% of farmers who had attended the event had made changes to their farm, while 31% were considering making changes in the future. In a study of demonstration farms, Roderick et al. (2000) found that around 40% of respondents surveyed had made some changes as a result of their visits to farms, and 8% had made significant changes. However, as might be expected, the success of the demonstration activity can vary considerably depending on the innovation being demonstrated. In a study of the Lincoln University Demonstration Farm (NZ) the innovation of dairy farming with low grazing residuals was reportedly adopted by 82% of survey respondents, a “nil induction policy” for dairy cows

was by 36% of farmers but the strategy of synchronizing heifers to calve one week before the herd was adopted by only 29%. (Pangborne et al., 2011; Pangborne, 2012).

While other studies have also found demonstration farms to be highly valued among farmers (Gasson & Hill, 1990; Murphy, 2014) some caution as to the virtues of demonstration farms is also warranted. Hill et al. (2017) found that – without taking non-quantifiable or long-term benefits into account – public expenditure on delivering knowledge transfer to farmers via "Farming Connect" (which included demonstration farms) "was about as effective as giving the funds direct to farmers as a way of increasing their income". This raises issues about how we measure the success of demonstration activities in PLAID. Given farmer's appreciation of demonstration farms and their continued use for commercial demonstrations it may be that positive outcomes are apparent not only as measurable economic outcomes but also as non-quantifiable outcomes (e.g. successful farm succession, farm-level resilience), and that these outcomes nevertheless contribute to sustainable agriculture over the long term.

3 Developing a demonstration farm typology in PLAID

3.1 Constructing typologies

Classifications of similar farm/farmer types are often used in research to account for the heterogeneity in farming communities by producing a limited classification of farms/farmers with structural or psychological similarities (e.g. Daloglu et al., 2014; Weltin et al., 2017). In the case of farming communities this is an important tool. Variations in environment and culture have meant that farming populations in Europe can be extremely diverse (Morris, and Evans, 2004) making understanding and simplifying diversity an important part of the policy development process (Pacini et al., 2014). It is perhaps a reflection of the low level of attention paid to demonstration activities in the academic literature, that there has been no attempt to develop a theoretically informed typology of farm demonstration activities – despite there also being evidence of a vast array of types and purposes. Consequently, there is a need within the PLAID project to develop a new theoretically and empirically informed typology of demonstration activity types across the European Union.

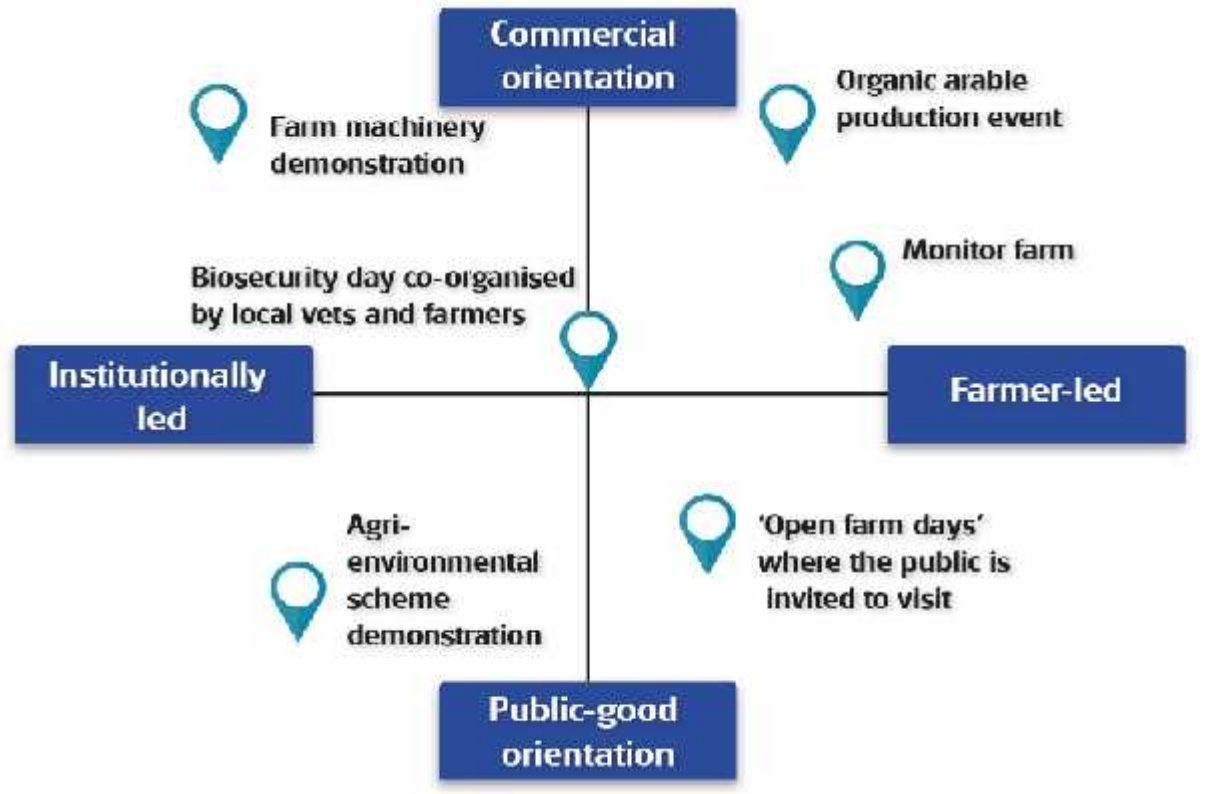
Constructing typologies can be done by a variety of means. However, there are two main categories – the 'a priori' and 'typification' approaches (Iriazoz et al., 2007). For a priori approaches the typology is created by researchers using their knowledge and judgement to create theoretically informed typologies (e.g. Madsen & Adriensen, 2004; van der Ploeg et al., 2009; Bohnet et al., 2011). Within this group matrix approaches – the use of two axes to define four or more typological groups – have been employed (Meert et al., 2005). Typification approaches, on the other hand, employ statistical techniques to create the typology – particularly when large or complex databases are involved. A variety of methods have been used in agricultural studies including classification trees (Valbuena et al., 2008), Q-Sort methodology (Brodt et al., 2006; Davies & Hodge, 2007), and particularly cluster analysis (Briggeman et al., 2007; Gaspar et al., 2008; Morgan-Davies et al., 2012).

3.2 The PLAID draft typology framework

In the PLAID proposal we used the expert informed matrix approach (e.g. Meert et al., 2005) to develop a typology based on two dimensions: (a) demonstration objectives – the commercial product (private goods) vs public good dimension, and (b) demonstration

organiser – the extent to which the demonstration activities are administered from the bottom-up or top-down. This ties in with two important aspects outlined in the PLAID proposal. First, institutional setting: whether the demonstration activity is predominantly "peer-to-peer" (i.e. farmer-led), or "top down" institutionally-led. The second dimension relates to the extent to which an innovation is commercially (economic) or public good (socially or environmentally) oriented provides us with a "sustainability" dimension (see below).

Figure 2 : PLAID demonstration farm typology.



Institutional setting provides an important dimension in that it emphasises the extent to which the demonstration is "peer-to-peer" – a key concept in PLAID. A basic typology can be drawn around three commonly referred to groups.

1. Institutionally governed demonstration farms: established by a research centre, special interest group (e.g. conservation charities), agribusiness or agricultural educational organisation. Farms in this category typically demonstrate the physical feasibility or profitability of a new management system (Clark, 2010). The key criteria for this demonstration type is that the goals and objectives of institutionally initiated demonstration activity are often determined by those involved in the industry, but outside of the farming community itself.

2. Farmer-led demonstration farms: established by farmers or groups of farmers to meet their needs. Examples of these 'farmer-led' demonstrations are 'monitor farms', established in New Zealand and subsequently adopted in Europe. A group of farmers agree to meet at established intervals to propose and assess innovations for adoption on-farm. Decisions on which innovation to investigate are made by the group.

3. Informal demonstration farms: local farmers identified as 'good farmers' are observed informally by others in the community. The observation of farms by neighbours is known to be an important way of transferring knowledge within the farming communities – either through direct observation or asking the farm advisor informally what has been done (Burton, 1998; Farmer–Bowers and Lane, 2009; Strand et al., 2014). These farms are difficult for outsiders to identify, but they are crucial for influencing change (e.g. Poudel et al., 2015; Hallam et al., 2012).

The second dimension of private vs public goods represents the extent to which the demonstration activity is commercially oriented as opposed to being oriented towards providing social or environmental benefits. This dimension is important to represent the sustainability aspect of the demonstration activities with some activities focused purely on promoting economic benefits, others purely public goods benefits, and yet others falling between the two. As noted in the sustainability section of the conceptual framework (see section 6), the extent to which a demonstration activity or farm promotes sustainable agriculture (or not) is difficult to ascertain because sustainability is relevant at the farm rather than the demonstration level. Consequently, a demonstration activity that predominantly promotes a commercial product (such as farm machinery) could nevertheless contribute to sustainability if it helps maintain the profitability of family farmers while not harming other sustainability dimensions. However, the extent to which the demonstration promotes public goods or commercial products at least informs us on which of the three pillars of sustainability (economic, social and environmental) the demonstration activity is directed.

3.3 The PLAID final typology

Owing to the lack of an established typology within the literature, we will use the initial demonstration farm typology from PLAID as the basis of our preliminary typology. However, while figure 2 places example "farm types" within the two dimensions, the dimensions serve predominantly as a positional axis for demonstration activities – rather than forming the basis of a complete typology. The final typology will be based largely on a typification approach using data from the geo-referenced inventory in WP3. Here data will be subject to a cluster analysis (e.g. Briggeman et al., 2007; Gaspar et al., 2008; Morgan-Davies et al., 2012) in order to define demonstration activity types and describe their characteristics for use in project work packages (in particular, the case studies). The content of the clusters used in the typology will be based on utility for particular purposes (e.g. distinguishing types of farms on the basis of distinctive support needs or other issues).

4 Assessing demonstration success. A theoretical and methodological perspective

Prior to assessing the individual success factors of a demonstration activity, it is important to identify its main elements, which can be then taken as a basis for further evaluation. It is proposed here that these elements can be classified along three broad categories:

(i) inputs (provided financial, technical, human resources);
(ii) access (inclusiveness in geographical, social, and economic terms);
(iii) demonstration process (methods used, contents, interaction forms).

All these elements contribute to what can be categorised as a demonstration activity, which is attributable to the diverse means for providing farmers with "an explanation,

display, illustration, or experiment showing how something works" (Collins English Dictionary) that can be subsequently applied in their own farming practices to bring about positive changes on their farm (see Section 2 for discussion).

Measuring success of a demonstration activity largely depends on two aspects, which are quite crucial in defining the criteria for the success of a given demonstration activity (which largely depend also on the overall objective of the activity):

(i) The dimension of the demonstration activity that one wants to assess (=success in what; e.g. in terms of organisational aspects of the demonstration event or in terms of facilitated changes in farmers' knowledge, behaviour, practices, social and economic resources, etc.);
(ii) The perspective chosen to assess the success (=success in who's view; i.e. organiser, funder, demonstrator, participant, or wider community).

It is proposed here that in total five key impact domains of demonstration activities vis-a-vis the farm/farmer are identified upon which a success of a demonstration activity can be assessed (with knowledge and learning as underlying all of those – economic, social, and environmental – dimensions):

(i) Productivity & profitability (efficiency of production; increased output per unit of input; increased ability to produce a return on an investment, make profit);
(ii) Resilience (improved capacity to adapt to changes);
(iii) Environmental sustainability (responsible use of and attitude towards environmental resources);
(iv) Quality of life (improved material/working/health/safety/leisure conditions);
(v) Empowerment (enhanced self-reliance, skills, social capital).

When assessing success of a demonstration activity (performance measurement) along these impact domains one should also take account of the related differentiation between immediate/direct and longer-term/broader effects featuring the following differences (see e.g. EC 2015):

(i) Outputs – results achieved immediately after implementing a demonstration activity (e.g., the number of trained farmers);
(ii) Outcomes – later (medium-term) changes that have occurred as a result of a demonstration activity (e.g., application of the gained knowledge by farmers on their own farms);
(iii) Impacts – broader (long-term) changes affecting direct beneficiaries of a demonstration activity or a wider community/institutions/environment that become evident several years after the activity has taken place (e.g., increased annual productivity levels of local farms).

Last, but not least, it should be considered that not all factors can be successful in all demonstration types – or are more successful in some demonstration farm types than others (i.e. type-dependent success factors). Situations where a "key factor" is successful in some circumstances but not in others need to be explored to see whether contextual factors related to demonstration type were important in their success.
It must also be noted that the evaluation should be led/informed/supported by a specific theoretical perspective, for instance, to avoid linear views of the innovation process (Molas-Gallart & Davies 2006) that to a large extent underlie demonstration activities. Some of the potentially useful theories for the conceptual model (aside from or in addition to behavioural theories) are related but not limited to the domains of social learning, agricultural knowledge and innovation systems (AKIS), diffusion of innovation, interactive innovation, science communication, and social capital.

Figure 3 : Conceptual model for assessing agricultural demonstration activity

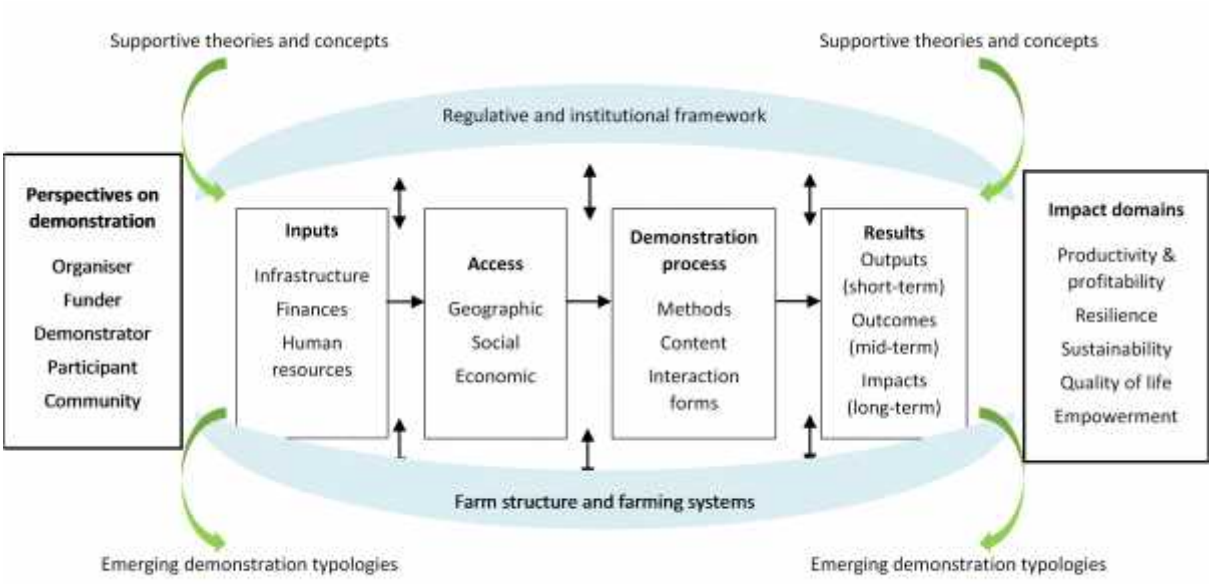


Figure 3 aims to summarise the proposed conceptual model underlying the analysis and assessment of agricultural demonstration activities. It integrates the key groups of elements of a demonstration, positioning those in the broader context of the regulative and institutional framework as well as the given farm structure and farming systems that can both enable and limit the scope and specific characteristics of demonstrations in the given temporal and spatial settings. It also emphasises the diverse effects of demonstration in terms of both timing and impact domains, simultaneously acknowledging the presence of potentially varied perspectives on this activity depending on the role and primary interest of the assessor. Last, but not least, it highlights the impact of a chosen theoretical perspective on the way a demonstration activity is viewed and interpreted, further leading to new typologies and ways of categorising this phenomenon and inevitably feeding back into both theory, policy and practice of demonstrations.

As already noted above, defining success is a rather complex issue that requires a prior definition of evaluation framework and selection of criteria and indicators. Nevertheless, some initial ideas of selected success factors/conditions of agricultural demonstration activities can be identified from reviewing accounts of earlier research on specific practices in various countries all over the world (including the developing countries) (i.e. Bailey et al. 2006; Elmquist & Krysztoforski 2015; Gandhi et al. 2009; Hancock 1997; Heiniger et al. 2002; Knapp 1916; La Grange et al. 2010; Leeuwis 2004; Lukuyu et al. 2012; Magill & Rogers 1981; McDowell 1929; Millar & Curtis 1997; Warner 2006).

Overall, the success factors stemming from these accounts, can be attributed to six main groups of items – (1) goal/topic, (2) demonstration site/host, (3) facilitator, (4) motivation/incentives, (5) demonstration process, (6) publicity/follow-up. The following list sets out the main factors of a successful agricultural demonstration (in total 24 key principles) covering these groups:

- CLARITY – defining a clear objective/goals of the demonstration;
- TOPICALITY – choosing a subject matter that is attractive and timely for local farmers, addressing needs/problems faced by farmers at the given moment;

- APPROPRIATENESS – providing content that is appropriate for the current season, local set of conditions, types of farms;
- DEMAND-ORIENTATION – identifying local market demand for and interest in the given information and/or technology in due time;
- USEFULLNESS – offering tangible solutions which are possible, practical and easy to apply and bring clear benefits in the daily practices of farmers;
- ACCESSIBILITY – facilitating participation of individuals of both genders, various age and socio-economic groups, having different responsibilities on the farm;
- ENGAGEMENT – enabling early engagement of local farmers in the design and implementation of demonstration;
- PUBLICITY – ensuring wide accessibility of timely and sufficient information on the demonstration through promotion and marketing;
- PERTINENCE – choosing the demonstration site depending on the type of demonstration (one-off vs. monitoring);
- RESTRICTEDNESS – demonstrating only one or two objects/practices at a time;
- PROXIMITY – selecting a demonstration site located at a distance easily reachable by the target local group of potential attendants;
- REALISM – undertaking demonstration under realistic farmers' conditions and management;
- ALTERATION – ensuring limited lifetime of a single demonstration farm, periodic change and diversification of host farms;
- MEDIATION – ensuring mediation in the process of demonstration to facilitate knowledge communication;
- COMPETENCE – attracting a progressive advisor/demonstrator with high level of expertise and experience in the given field;
- CREDIBILITY – choosing a demonstrator that is a practicing farmer, well-known and generally respected in the local community, acquainted with local people, conditions and farming practices, representing the same socio-economic strata as the targeted farmers;
- INSTRUCTION – ensuring prior training in teaching methods and continuous support for farmer trainers;
- RAWARD – providing financial and/or non-financial incentives for demonstration hosts/trainers as an inducement for involvement;
- ADAPTABILITY – taking account of and tackling the variation in learning capacities and styles of individual farmers, ensuring a good balance of repetition and novelty;
- INTERACTIVITY – facilitating open debate, knowledge exchange (incl. advisor-farmer, farmer-to-farmer) and co-learning instead of unilateral knowledge transfer; balancing elements of passive and active (hands-on, experiential) learning;
- RECEPTIVENESS – taking account of and providing room for local/indigenous/practice-based knowledge of participants;
- VISUALITY – making active use of different visualisation techniques and observations in the demonstration process;
- VOLUNTARITY – encouraging personally motivated rather than imposed participation by farmers;
- CONTINUATION – organising repeated sessions, follow-up meetings, coaching, individual counselling for the involved farmers along with supplementary sources of information.

It should be noted that these factors are derived from a review of literature and practice cases, and not every practical demonstration should entail all factors in order to be successful. Also, referring to the three groups of categories of elements related to demonstration (inputs, access, demonstration process) it is likely that a single success factor is simultaneously related or contributes to several of these categories, int. al. implying the importance of initial planning stage of the demonstration activity on the further characteristics and wider implications of its practical execution.

As concisely summarised by Opara (2008): "Access to the right information at the right time in the right format and from the right source may shift the balance between success and failure of the farmer" (p. 289; emphasis added). A review of studies on farmers' participation in learning opportunities has noted that barriers to participation in learning or change opportunities may be factors related to (i) farmer characteristics, (ii) characteristics of individual and institutional providers of education and training, (iii) learning content, (iv) accessibility to learning opportunities, and (v) method of delivery (Fulton et al. 2003: 18-20).

In assessing the top success factors a qualitative evaluation as to how critical the factors are for success can be useful. Thus, all factors can be evaluated on a scale e.g. critical/important/desirable. This can serve as an indication of what factors to prioritise if in establishing a demonstration project a decision needs to be made concerning which factors to follow. At the same time a critical note should be made regarding the possibilities for identifying best practices since in most cases the identified success factors are rather case-specific and highly dependent on the socio-economic conditions (e.g. industrialised vs. developing countries), cultural traits of the region or specific local community (e.g. mentality, preferred learning styles), etc.

Academic literature and existing policy frameworks offer some suggestions that could be used for choosing indicators for demonstration and peer-to-peer learning assessment. Yet, at the outset it should be realised that indicator selection poses several methodological problems. First, indicators will be meaningless if they are not properly contextualised. Mainly this means that certain reference values (benchmarks) should be set that allows interpreting the indicator performance. Second, the selection of indicators on its own is a challenging task. There are several ways how to think about the selection of the indicators. Indicators can emerge from goals. This is, undoubtedly, the easiest way how to think about the indicators yet it offers only limited insight into the assessed process. Selection of indicators can also be restrained by the availability of data. Finally, the reference values (benchmarks) and indicators are to be applied with precariousness and reflexivity given that there are no one-size-fit-all situations. The actual working of an indicator and the impact of demonstration activity generated will depend on the farmer's real life-situation, practical needs and existing knowledge base. There might be situations where a smaller indicator value may generate a greater demonstration impact and success, for example at critical moments of innovation, at times of urgent production issues and decisions, for the starting farmers, etc.

The Monitoring and Evaluation Framework of the Common Agricultural Policy uses RACER criteria (Relevant, Accepted, Credible, Easy and Robust) (EC 2015: 14) to select indicators. The World Bank in the document offering recommendations for AKIS monitoring and evaluation names nine criteria that should guide indicator selection. Indicators should be relevant, unambiguous, meaningful, significant, practical, provide disaggregated information, quantifiable, and able to reflect changes (WB 2000). It is worth adding that recommendations given by other experts recognize qualitative indicators as well. For a more complex and holistic selection process participatory methods can be used. These methods allow incorporating multiple perspectives thus bridging the gap between the different benefits various stakeholders have. Thus, the final selected list of indicators should illustrate the perspective it represents (e.g. Organiser, Funder, Participant or Demonstrator); should include clear measurement procedures; the assessment of credibility of indicators; assessment of data availability for the indicator.

It is suggested that the effectiveness and success of a demonstration activity should not be attributed merely to immediate practice change on the farm, but rather to the fact of better equipping farmers "to make practice changes if and when other barriers to adoption have been overcome" (La Grange et al. 2010: 262) thereby promoting capacity building in farmers, enabling them to be more informed in their decision-making and

increasing the likelihood of future adaptations. This is largely in line with the AKAP model of assessing extension impact based on the sequence of agricultural extension efforts, namely, Awareness-Knowledge-Adoption-Productivity (Evenson 1998). This model rests upon the premise that initial farmer awareness provides basis for building knowledge through testing and experimenting, then leading to the adoption of technology or practices and consequently resulting in changes in farmers' productivity.

There are different data sources and methods that can be used for assessing the success along specific factors and criteria. Yet, the chosen evaluation methods and the data sources should be adapted to the type of the demonstration activity to fit into the format of the event. Overall, using secondary data might be cheaper and faster than relying on primary data. However, in the cases when the costs of getting right estimation are high, primary data can be an option. The World Bank suggests that researchers consider using national level databases and specific studies to collect data (WB 2000). The specific studies could mean: sample surveys; rapid rural appraisals; special topic studies; diagnostic case studies; external peer reviews. Apart from sources identified process data can be used – these include the practical information describing the process. Data can also be collected by asking different stakeholders to reflect about the process using ex-ante, ex-post surveys, interviews of participants and/or organisers.

Assessment of demonstration success is a challenging and multifaceted task given the complexity and multidimensionality of an agricultural demonstration activity as suggested in the conceptual model and analysis above. Therefore, participatory methods of knowledge exchange and co-creation like focus-groups and workshops with participation of farmers, advisors, researchers, cooperatives, supply industry, food chain organisations and other stakeholders might be beneficial and useful approach to discuss various factors and aspects of successful demonstration. Generally, it is advised that both quantitative and qualitative methods are used in this kind of assessments since advocates of the use of a multi-method approach in the evaluation process of the impact of extension and advisory services emphasise the importance of taking account of the perceptions and perspectives of different actors (Madsen & Adriansen, 2004).

5 What makes demonstration successful? A theoretical perspective on behavioural change through demonstration

While theories of behaviour are sometimes used to form theoretical frameworks for demonstration activities, the extent to which analysis of demonstration activities has been incorporated in the theoretical literature is rather limited. The reality is that behavioural theories generally inhabit an academic realm often based on clinical studies of 'captured' populations such as university students (Ojalehto & Medin, 2015), whereas demonstration activities (and the influence they have on behaviour) have a very practical application and theories are often developed by the practitioners themselves. As such, models of innovation diffusion although often underlain by behavioural theories such as the theories of reasoned action and planned behaviour (e.g. Bailey et al., 2006; Garforth et al., 2006) are rarely simply replications of academic theory. Nevertheless, the rigorously tested behavioural theories may provide us with some insights into successful demonstration activities – in particular through their focus on the cognitive and social processes of behavioural change, rather than learning per-se (which is a far wider field of knowledge).

This section of the conceptual framework briefly details five main groups of theory and how the theoretical concepts within them may help explain the success or failure of demonstration approaches. These are:

1. Economic theories
2. Attitude theories
3. Persuasion theories
4. Cultural theories
5. Social theories

5.1 Economic theory – rational choice

The rational choice model is based on the key premises that individual self-interest provides the foundation for all human behaviour and rational behaviour is the result of cognitive deliberation (Hassell and Cary, 2007). Consequently, decisions are related to an internalised cost-benefit assessment, with the behaviour chosen being the one that maximizes the expected net benefit. A number of assumptions are made in the model, the most important ones being that (a) a sovereign individual (also called an actor or economic agent) has preferences that can be represented by a utility function, and (b) that the individual possesses perfect information (or searches optimally) and behaves consistently according to stable preferences. To function the model is dependent on a defined set of conditions being met: in particular, perfect information and perfect competition (Collier et al., 2010). Rational choice models are important in the context of agriculture because (a) both policies providing economic support and those intended to change farmer's behaviour (in particular agri-environmental policies) are based on the principles of rational economic decision making (Jackson, 2005; Bucholz et al., 2016) and (b) 'rational choice' is the model behind theories of innovation diffusion in agriculture where the assumption is that an innovation will be adopted eventually if it is economically viable (Stewart et al., 2002; Sneddon et al., 2011; Veisi, 2012). However, rational choice models have been heavily criticised for failing to reflect the bounded and imperfect nature of decision-making (Hassell and Cary, 2007; Musshoff and Hirschauer, 2014) or more specifically, as Higgins and Kitto (2004) contend, linear 'rational' models of agricultural innovation fail to address the complexities of farm practice. An overemphasis on rational economic decision-making in agricultural demonstration is thus seen as one reason research-extension attempts have failed in the past (Darnhoffer et al., 2012).

5.2 Attitude Theories

5.2.1 The Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is one of the most important behavioural theories in social psychology (Manstead, 2011). Rather than specifically focusing on how to change behaviour (see persuasion models below), it deals with the issue of how intention to behave is cognitively formulated and how ultimately this leads to actual behaviour. The model is depicted in Figure 5.1.

Figure 4: Ajzen's (1991) Theory of Planned Behaviour

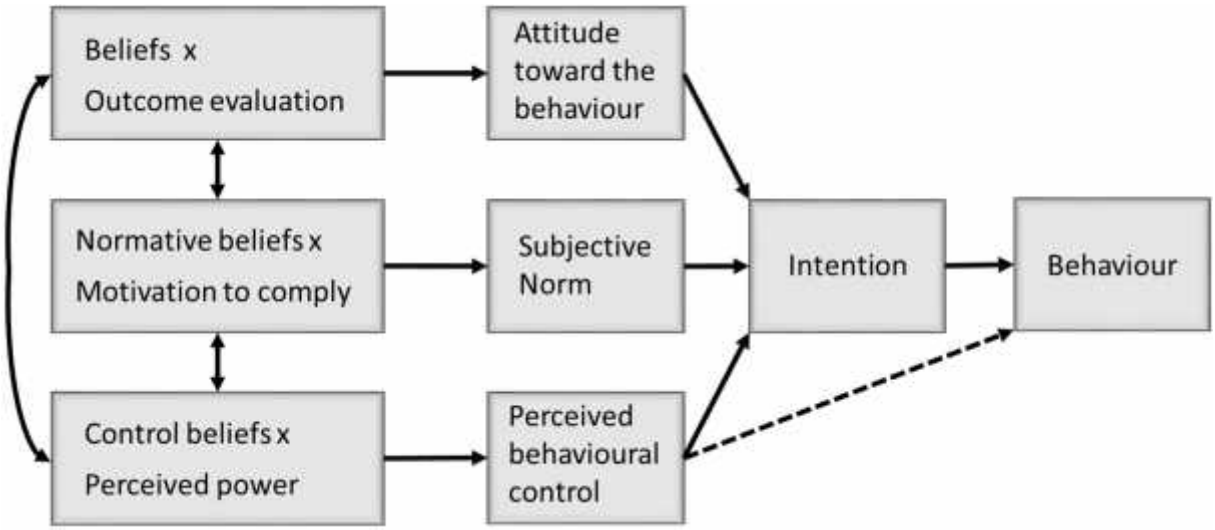


Figure 4 provides a definition of the terms used in the TPB along with the hypothetical example of what factors might be involved in the decision to purchase a new tractor. The three main constructs are attitude towards the behaviour (i.e. beliefs concerning the behaviour mediated by an evaluation of the extent to which that belief contributes to the behaviour in a positive or negative way), subjective norm (i.e. how one perceives significant others will view the behaviour and motivation to comply with significant others), and perceived behavioural control (i.e. what one believes could affect the performance of the behaviour and how much control the individual has over that factor).

Table 2: Details of the terms used in the TPB (source: Authors).

Behaviour	The behaviour e.g. Buy a new tractor	
Intention	The level of motivation to preform the behaviour	
Attitude towards the behaviour	Belief	Beliefs about the outcome of a specific behaviour e.g. a new tractor will increase my profitability
	Outcome evaluation	Beliefs about what "significant others" believe about the behaviour e.g. My best friend thinks it is a good thing to buy a new tractor
Subjective Norm	Normative beliefs	Beliefs about what "significant others" believe about the behaviour e.g. My best friend thinks it is a good thing to buy a new tractor
	Motivation to comply	Motivation to act in the way significant others think you should act e.g. I don't really care what my friend says
Perceived behavioural control	Control beliefs	Beliefs about factors that control the outcome e.g. It depends on whether I can afford one
	Perceived power	Ability to overcome control beliefs e.g. I can afford a new tractor

The key theoretical value of the TPB for understanding demonstration activities is that it explains five key factors need to be in place to promote behavioural change:

a) The beliefs about the behaviour may need to be changed and/or the evaluations about how positive or negative those outcomes are. This emphasises the importance of information transfer, but in a way that challenges or strengthens existing belief structures.
b) The perceived views of others can have a significant influence on behaviour and, as such, working at the community level (rather than isolated individuals) may provide benefits – i.e. the higher the level of community engagement with the demonstration activity, the more likely change occurs.
c) Promoting confidence in the farmer's ability to achieve positive outcomes is also likely to aid the success of interventions by improving PBC. Josefsson et al. (2017) also suggest that focusing information on feasibility could affect willingness to change farmers' behaviour where PBC is an issue.
d) Fishbein and Ajzen (1975) note that the model functions best when the level of specificity of the attitudes matches that of the behaviour. For demonstration activities, this means that targeting should be for specific behavioural change rather than general behavioural change. Interventions need to be targeted at specific beliefs about specific actions.
e) Finally, while it is important to transfer knowledge (i.e. increase knowledge or introduce new beliefs) it is also important to focus on beliefs about the desirability or ability of the new knowledge. For example, educating farmers about how to farm organically is unlikely to achieve change if they do not evaluate the outcomes of organic farming positively.

Although the TPB model is not specifically focused on the promotion of behavioural change it "represents a reference model in the literature on innovation diffusion" (Peluso, 2015, 254). For example, applications have looked at uptake of technological innovations in agriculture (e.g. Garforth et al., 2006; Rehman et al., 2007), the adoption of tractor safety measures (Witte et al., 1993; Slater, 2006), and the reasons for non-adoption of demonstrated activities at demonstration events (Gartforth et al., 2003; Bailey et al., 2006).

Researchers have also added other components to the model that have been found to influence the relationship between attitude and behaviour in studies of agricultural decision-making. In particular :

Self-identity

Self-identity has been found in a number of cases to be important in studies of farmer's behaviour (Burton, 2004; Burton & Wilson, 2006; van Dijk et al., 2015, 2016). Self-identity has been found to be particularly relevant to conservation activities. For example, Van Dijk et al (2016) used an adapted TPB model to look at farmer's adoption of voluntary agri-environmental schemes and found that, of all the variables tested, self-identity showed the strongest relationship with intended environmental behaviour (stronger than attitude, SN, or PBC). Josefsson et al. (2017) found similarly that participation in the Swedish Volunteer & Farmer Alliance lead to higher self-identity appraisals (as a conservationist) in relation to both participation in AESs and unsubsidised conservation activities.

Moral norms

Moral obligation is believed to contribute to behaviour in specific circumstances when dealing with moral issues. Wauters et al. (2017) found that moral norms were important when making decisions on environmental measures and, in both cases, this was moderated by self-identity (notions of being a "good farmer"). Moral norms have also been found to have an important role in guiding farmers' behaviour with respect to animal welfare issues (Delgado et al., 2012).

5.3 Persuasion theories

While attitude based models focus on explaining why behaviours occur, an additional body of theory – the persuasion literature – focuses on the perhaps more salient question (for this study) of how are we able to change people's behaviours. Crano and Prislin (2006) observe that the most influential paradigms of persuasion are so-called "dual-process models". Dual process models contend there are two pathways to changing people's behaviours – one involves using peripheral cues (e.g. an attractive or well known speaker) or heuristics (e.g. "my farm adviser is usually correct") while the other involves the systematic analysis of the message (deliberative or central processing) – the sort of processing that occurs in the TPB (Carpenter, 2015). The more a judgement is based on central route processing the more it (a) persists over time, (b) resists attempts to change, and (c) affects other judgement and behaviour (Petty & Brinol, 2014). Thus, for demonstration activities where long-term behavioural changes are sought, there is clearly an imperative to encourage the engagement of central route processing. The dominant dual-process models is the Elaboration-Likelihood model (ELM) (Petty and Cappacio, 1986).

5.3.1 The Elaboration Likelihood Model

The key contention of the ELM is that variations in persuasion are attributable to the extent to which a receiver of a message is likely to engage in elaboration of the information (O'Keefe, 2002). In this respect, an audience engaged in central processing (as would generally be the case in demonstration activities) will be more likely to be persuaded by strong arguments than weak arguments – whereas, if the audience is not engaged and is only peripherally processing information, the argument strength is of lesser concern as they are less likely to detect whether a message is strong or weak (Carpenter, 2015). The ELM focuses on the issue of how to get people to engage in central-route rather than peripheral processing with three particular areas of the communication process identified as important: message factors (i.e. structure and content), receiver factors, and source factors.

Message factors

According to the ELM, there are two principal components of message factors that are likely to influence the persuasiveness of arguments, namely, message structure and message content. 'Message structure' – Different ways of structuring a message are known to influence its persuasiveness. For example, Petty et al. (1992) suggest that phrasing arguments as questions rather than statements is likely to promote reflexivity and therefore message elaboration. 'Message content' – message content has a strong influence on persuasiveness. In particular, when the topic of the message directly affects the ability of the receiver to reach their goals, the information is more likely to be carefully scrutinised and consequently, if the arguments are strong, attitudinal and behavioural change can occur (Carpenter, 2015). Other features of the message content have also been found to be relevant including 'Balance' – two sided arguments where opposing arguments are refuted are more persuasive than once sided messages (O'Keefe, 2002), and 'Phrasing' – positive phrasing is more persuasive than negative phrasing (Maheswaran and Meyers-Levy, 1990).

Receiver factors

Differing receiver characteristics mean that approaches for targeting behavioural change will not have the same impact on all of the target group. Many personal factors can influence the persuasiveness of arguments including: 'Memory recall' – those with high memory recall are more likely to use central route processing (Wood and Kallgren,

1988), and 'self-interest' – strong arguments become more persuasive as their personal relevance increases (Petty et al., 1992). Overall, as O'Keefe (2002) observes, the evidence for many of the receiver factors is complex and sometimes contradictory.

Source factors

Petty et al. (1992) suggest that the key to promoting behavioural change lies in understanding why and in what situations people are likely to respond positively to different sources. It has been widely established in the literature that high credibility sources are more persuasive than low credibility sources – to the point where attention has switched to dealing with issues of what affects credibility (Tormala et al., 2006, 684). Two main dimensions are important: Expertise: Expertise concerns whether the source is qualified to know what is right and what is not right. The accumulated literature on communicator credibility has long established the expert communicator as being more persuasive than a communicator who lacks expertise (Walster et al., 1966). Factors that may convince the recipient that the source is expert are primarily education, occupation and experience (O'Keefe, 2002). Trustworthiness: The trustworthiness dimension is associated with whether the source is perceived as being inclined to tell the truth, and concerns issues such as whether the source is open-minded-closed- minded, just-unjust, or selfish-unselfish. Trustworthiness depends on a number of characteristics of the source (i.e. speaker or company), such as, personality-based trust, institution-based trust, and interpersonal trust (Zhou et al., 2016).

5.3.2 Persuasion theories and agriculture

Despite their focus on attitude/behaviour change the use of persuasion theories in the agricultural literature has been relatively limited in comparison to the use of the TRA/TPB models. Nevertheless, the theory has been used to explore a range of behavioural change issues. Topics vary from communicating climate change issues to dairy framers (Waters et al., 2009), the adoption of conservation tillage (Andrews et al., 2013), and the construction of persuasive messages aimed at reducing the number of tractor accidents (Witte et al., 1993; Beaudin et al., 1997). However, despite the use of the ELM there is a tendency in these studies to simply take aspects of the theory either to use in the construction of a combined conceptual framework (mixing two or three theories – e.g. Beaudin et al., 1997) or to explore certain aspects of the issues at hand – in particular the concept of central and peripheral processing routes. In one of the more comprehensive applications, Jansen et al. (2010) used the dual processes of the ELM to explore the possibilities of targeting information on udder health management with both central and peripheral route processing. The study concluded that to use the central route processing effectively efforts were required to increase farmer's motivation to engage deliberatively by communicating a convincing message concerning acceptable levels of mastitis and the effectiveness of the recommended tools and methods.

5.4 Cultural theories

Unlike models of attitudinal change, cultural theories of behavioural change come from more than one disciplinary perspective (but mainly social-psychology and sociology). Nevertheless, there are similarities in the concepts of culture employed. For social psychologists, culture is:

> "the set of meanings that a group in a time and place come to adopt or develop, and these meanings facilitate smooth social coordination, clarify group boundaries, and provide space for information" (Oyserman, 2017, 434).

Culture thus represents a coalition of behavioural norms amongst one definable population that are distinct from those held by other populations. These norms can be

transferred to new members of the population, are often institutionalised (making them very pervasive) and function by providing resources for meeting individual and collective goals (Lehman et al., 2004). For sociologists the definition of culture shares many similarities with social psychological definitions. One of the most commonly cited and comprehensive definitions of culture is that of Kroeber and Kluckhohn (1952: 181):

> "Culture consists of patterns, explicit and implicit, of and for behaviour acquired and transmitted by symbols, constituting the distinctive achievement of human groups, including their embodiments in artefacts; the essential core of culture consists of traditional (i.e., historically derived and selected) ideas and especially their attached values; culture systems may, on the one hand, be considered as products of action, on the other as conditioning elements of further action"

As with the social-psychological definition of culture, meaning is also a critical factor in sociological definitions as the symbolic meaning of behaviours and artefacts (their cultural value) plays an important role in determining behaviour. Culture provides groups of people with a system of symbols with which to understand the world, it ensures that those with a shared culture are likely to react similarly when a 'problem' emerges (Cohen, 1985). The existence of cultures and sub-cultures within agriculture following different sets of cultural rules and thereby behaviours is widely recognised in the farming literature (e.g. van der Ploeg, 2003; Morris & Evans, 2004; Burton & Wilson, 2006). While socio-psychological models of culture exist (and have become more important in recent years - Ojalehto & Medin, 2015), sociological cultural theories are in more common usage and have been widely applied in agricultural studies.

5.4.1 The 'farming styles' approach

The 'farming-styles' concept is first laid out extensively (in English) in Jan Douwe van der Ploeg's (1993) paper "Rural Sociology and the New Agrarian Question". In this paper he outlines the historical origins of farming styles in the work of Hofstee (1946, 1985: cited in van der Ploeg, 1993) and his approach towards understanding the "rich variety of agrarian life" (1946: 17) in Dutch agriculture. In this paper van der Ploeg describes a farming style as:

> "a cultural repertoire, a composite of normative and strategic ideas about how farming should be done. A style of farming involves a particular way of organising the farm enterprise: farm practice and development are shaped by cultural repertoire, which is in turn tested, affirmed and if necessary adjusted through practice. Therefore a style of farming is a concrete form of praxis, a particular unity of thinking and doing, theory and practice" (241).

The key to the farming styles perspective is the importance of the relationship between the technical manner in which the land is farmed and the development of a culture based on the farming process. According to Ploeg, these aspects then combine such that "ideas and practice" reinforce each other. In his book "The Virtual Farmer" van der Ploeg (2003) suggests that a cultural repertoire comprises a 'moral framework' – an account of how relationships between people and the land should be performed that is enforced through interconnected social norms. He notes that the metaphorical "virtual farmer"

> "is an image developed in the expert system. It concerns the farmers (or grower) as s/he should be and should function according to the assumptions that are axiomatic within this expert system. The same metaphor also refers to agriculture as a whole – at least, as it should be – and to farms as they should be." (P22).

The concept of cultural repertoires has important implications for farmers behaviour and this is reflected in the large number of studies that have used farming styles as a conceptual framework over the last two decades. For example, Hammes et al. (2016)

applied the concept of farming styles to identify four groups of farmers who differed in farm and management parameters, attitudes towards agriculture, farming objectives and economic success. While all rejected the agri-environmental measure under study they had different reasons for doing so, leading the authors to conclude that communication of the scheme needed to be targeted differently to the different groups of farmers. From the same body of work, Eggers et al. (2015) found that approaches to promote adaptation to climate change needed to be targeted differently to the different groups, with rational and economic facts influencing "yield optimisers" and "modernists", while emotional appeals were more effective for "idealists" and "traditionalists". The conclusion that policies and communications need to be targeted differently for different farming types is the almost inevitable outcome of studies that use the farming styles approach – for example, with regard to agri-environmental payments in Austria (Schmitzberger et al., 2005), biodiversity conservation in Ireland (O'Rourke et al., 2012), mountain pasture management in Austria (Kurz, 2013), and production sustainability of soy producers in Brazil (Vennet et al., 2016).

5.4.2 The relevance of the "good farmer" identity

Unlike the "farming styles" approach, the "good farmer" approach is not attributable to a single author, but rather is a construct around which an increasing number of researchers are basing their research. Burton (2004) contends that the good farmer identity consists of a series of role definitions "good farmers do/are …" or "good farmers don't/aren't …" which validate (or otherwise) social position as a farmer within a community. For example, in Saugeres' (2002) study in France the good farmer was identified as someone who could feel a connection with the earth, has an innate understanding of nature, recognises their dependency on the land, is not focused on profit, and is male. Other roles attributed to the "good farmer" include taking good care of animals (Bock et al., 2007), knowledgeable management of field crops (Vaze, 1998), tidy management of farmland (Burton, 2012), producing the best crops and livestock (Gasson, 1973; Egoz et al., 2001), being a good steward of the land (Farmer et al., 2011), having physical contact with the fields (Burton, 2004; Kaljonen, 2006), owning the latest technologies (Hansen, 2015) and using them in a technically competent fashion (Dockes & Kling-Eveillard, 2007) (but also being able to farm without using technology, Tsouvalis et al., 2000), and being self-sufficient (Brandth & Overrein, 2013) – to name but a few. On the other hand, there are also counter roles that can lead to a farmer being classified as a bad farmer by peers (in certain communities) including planting trees (Burton, 1998) and engaging with certain agri-environmental policies (Burton et al., 2008; Wauters et al., 2106).

Within these general roles defining good farming are even more narrowly defined skills. For example, within the scope of tidy farming, the production of straight lines (and tramlines) on the landscape are indicative of skills in tractor driving and attention to detail, while even emergence of crops in a field is indicative of setting machinery correctly and planting in the correct conditions (Burton et al., 2008; Burton, 2012). Because these activities play important social roles in farming communities, concepts of good farming can interfere with the economic logic of innovation diffusion (farmers will adopt an innovation if it is economically viable) by making economically rational decisions socially irrational – i.e. adopting new techniques or production types that are not in keeping with "good farming" can result in loss of social status in the community (Burton et al., 2008).

"Good farmer" cultural norms can have a positive or negative affect on innovation diffusion – depending on whether the innovation is in keeping with cultural norms or otherwise. In extreme cases, where the innovation is completely out of keeping with the definition of a "good farmer", concepts of "good farming" could prevent innovation uptake entirely. However, culture is not immutable but rather is subject to constant usually slow change. As a result, the definition of good farming can change over time.

Examples in the literature include changing from farming roles to management roles through the uptake of robot milking machines (Driessen & Heutinick, 2015), a reconsideration of the role of woodland management (Soini & Aakkula, 2007), the increased role of financial management in defining good farming (Drummond et al., 2000), increased importance of maximising production (Kizos & Kristensen, 2011), and even the declining importance of raising a successor to take over the farm and ensure continuity (Brandth & Overrein, 2013).

6 Sustainable Agriculture – the PLAID Perspective

The importance of demonstrating activities that promote "sustainable agriculture" is emphasised in the "specific challenge" of the call text which begins by outlining the importance of improving the sustainability of European farming systems. Further, the project is to contribute to the "European Innovation Partnership 'Agricultural Productivity and Sustainability'" network (https://ec.europa.eu/eip/agriculture/node/50). Here, EIP-AGRI contends its objective is "to achieve more with less" and to ensure a steady supply of food, feed and biomaterials while sustainably managing the natural environment. To contribute to the EIP-AGRI network and address the sustainability call in the text, PLAID thus need to consider the role of demonstration activities in promoting sustainable agriculture and, in particular, to define how the notion/definition of sustainability is to be applied across the project in the framework and case studies.

6.1 Sustainable agriculture: definitions

The concept of "sustainability" is a complex one (with at least 50 different definitions and circumscriptions of sustainability in existence – Faber et al., 2014) and, as a result, is regularly subject to critique. For example, the concept is seen as confused (Bolis et al., 2014) and in a state of "conceptual chaos" (Vallance et al., 2011). The concept of "sustainable agriculture" has similar issues. Even early in its use, researchers noted that it was vague and thus easily adopted by special interest groups (Keeney et al., 1994) as well as being dependent on subjective visions of what agriculture should look like (Hansen, 1996). This problem has not been resolved over time. Velten et al. (2015) review the literature in an attempt to provide a comprehensive definition of "sustainable agriculture". They concluded that the current concept of sustainable agriculture "cannot be streamlined" into a single definition because of its varied and contradictory aspects.

Many publications cite the US Department of Agriculture 's definition from the 1990 Farm Bill as the most comprehensive and accepted single definition of sustainable agriculture (e.g. Aldy et al., 1998; Hilden et al., 2012; Velten et al., 2015). This contends that sustainable agriculture is an integrated system of plant and animal production that should

(1) satisfy human food and fibre needs
(2) enhance environmental quality and the natural resource base upon which the agriculture economy depends
(3) make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls
(4) sustain the economic viability of farm operations
(5) enhance the quality of life for farmers and society as a whole.

References in European Union documents vary. The 1999 communication "Directions towards sustainable agriculture" (EC, 1999) has a strong focus on environmental

sustainability – suggesting that sustainability is about balancing the use of natural resources for long-term agricultural production with the protection of the environmental and cultural heritage in line with society's values. As a result, according to Binder et al. (2010), much research into sustainability of agriculture has focused on environmental sustainability and neglected both the economic and social aspects of agriculture. However, in 2012 the brochure "Sustainable agriculture for the future we want" (EC, 2012, 2) employs the triple bottom line approach to sustainability, defining sustainability as going beyond a purely environmental issue to include economic viability as well as social acceptability such that:

> " The delivery of public goods such as environmental benefits is closely interlinked with the capacity of agriculture to be economically sustainable, generate adequate family income, and be socially sustainable. The thrust is to improve the quality of life in rural areas."

A rhetoric emerging currently within the sustainability field is that of "sustainable intensification" (also termed 'ecological modernisation' and 'eco-efficiency' – Tittonell, 2014). A 2014 report commissioned by the RISE foundation for the EU (Buckwell et al., 2014) contends that the sustainable intensification involves the simultaneous improvement of productivity and environmental management such that yields are increased without adverse environmental damage. This concept is being promoted by the EU, for example, in the recent establishment of a European Training Network (2016-2020) to train 15 early stage researchers in managing the soil and water impacts of agriculture for sustainable intensification. While Schiefer et al. (2016) contend that within the EU 40% of agricultural land is suitable for sustainable intensification, other researchers are strongly critical of the concept, suggesting it constitutes only a "slight greening" of the industrial agricultural model and thus is essentially meaningless (e.g. Altieri et al., 2017).

In PLAID we contend that agriculture cannot be sustainable unless it is economically viable – thus we need to move beyond the earliest definitions of sustainability as purely an environmental issue and incorporate wider concepts of sustainability. To achieve this we employ the triple bottom line or three pillars of sustainability model (e.g. Kuhlman & Farrington, 2010; Sardain et al., 2016). This model has its early origins in the Brundtland report on sustainability (WCED, 1987) and suggests that there are three main dimensions to sustainability – social sustainability (or people), environmental sustainability (or place) and economic sustainability (or profit) with sustainability being achieved when these three pillars are balanced such that all can be maintained simultaneously in the long term (Murphy, 2012). Although some researchers have argued for changes to the model (e.g. the inclusion of cultural sustainability as a pillar (Soini & Birkeland, 2014) or incorporating three dimensions to the "place" pillar (Seghezzi, 2009)) and others have suggested the distinction between the pillars is "conceptually fuzzy" (Kuhlman & Farrington, 2010), this model has been widely applied in the sustainable agriculture literature (e.g. Rasul & Thapa, 2004; van Calker et al., 2005) and provides a practical, if not perfect, solution to conceptualising sustainability.

6.2 Which innovations contribute to "sustainable agriculture"?

Developing a practical means of assessing whether development is sustainable has proved extremely difficult. Sardain et al. (2016) argue, for example, that over 20 years after sustainability was identified in Agenda 21 as a principal objective for nations, there is still no agreement on how to measure sustainability. Tait and Morris (2000, 253) identify a similar issue with agricultural sustainability noting that "precise, repeatable and value free" measures of sustainability are required if sustainability is to become a useful

concept for farming systems. This issue is even more problematic on the individual innovation level. On one hand innovation is critical to the development of an agriculture that is both productive and sustainable – to the extent that level of innovation itself can be an indicator of the long term sustainability of farms as meeting sustainability objectives requires constant innovation (Ryan et al., 2016). On the other hand, however, the extent to which innovation contributes to sustainability is extremely difficult to measure as it is the collective effect of innovativeness that determines the sustainability of the farming system, not the characteristics of any individual innovation. The systemic nature of agriculture means that it is the overall performance of the system that determines "sustainability" and this depends on many interrelated factors that differ among systems and change over time (Ripoll-Bosch et al., 2012). Thus as Pretty (1994, 39) observes, there is no "fixed set of practices or technologies" that will necessarily lead to sustainable agriculture.

For PLAID a key problem is that the focus of the study is on the demonstration activities, yet sustainable agriculture takes place at the farm system level (Frater & Franks, 2013; Ryan et al., 2016) – thus the focus of the study and the objective of assessing innovation for sustainable agriculture are not easily compatible. As Ryan et al. (2016, 116) put it with respect to innovation for sustainability:

> "Research and business provide inputs into farm-level innovation, but actual innovation only occurs when farmers put something new into use."

Consequently, sustainability can only be accurately assessed through observing how the innovation is applied within the overall farm system, not by assessing any characteristics of the innovation itself at the demonstration level. Even innovations that appear to be focused solely on profitability and could be used in a manner that promotes unsustainable land use will contribute to sustainability when applied to a farming system in a sustainable manner.

A further problem for assessing innovation's contribution to sustainability comes from the stage in the development process at which innovations are often demonstrated. Schott & Geels (2008) observe in the context of strategic niche management (see section X ?? – the MLP) that new agricultural innovations with "sustainability promise" tend to be crude and inefficient when they are recognised as "innovative", which means they are unable to compete immediately with established technologies. Furthermore, farmers are often initially unwilling to make a transition to new and more sustainable approaches because of " … (perceived or real) increased economic risk, including the cost of materials and equipment, the uncertainty of profitability and potential reduction in yields" (Teschner et al., 2017, 99). This has consequences for any assessment of the "success" of demonstration approaches as innovations that promote sustainability may not be adopted in the short term however effective the demonstration activity is. The necessity of being put into use on the farm for the innovation to become evident (Ryan et al., 2016) suggests that the true extent to which innovations contribute to sustainability may only be assessible years after the demonstration activity itself.

6.3 PLAID's conceptual approach to assessing agricultural sustainability

Assessing the extent to which innovations contribute to sustainable agriculture on the basis of the demonstration activities themselves requires an approach that simplifies the complexities discussed above: How can we assess a demonstrated activity's contribution to sustainability without detailed exploration at the farm system level? A number of studies have contended that overall agricultural sustainability can be assessed by considering whether the system achieves a balance between economic, environmental

and social dimensions of sustainability (e.g. Bezlepkina et al., 2011; Bachev, 2017). Others suggest that bottom up participatory assessments of sustainability are most effective at assessing the relationships between the sustainability pillars and therefore any integrated assessment of agricultural sustainability in multi-functional agriculture (Binder et al., 2010; Ripoll-Bosch et al., 2012). However, others still have tried to develop quantitative measures of integrated sustainability (e.g. Bachev, 2017).

In PLAID we propose to gather information on sustainability from within a broader question concerning the motivation for hosting demonstrations on the farm. Respondents to the survey are asked to rank their 5 most important reasons for organising demonstration activities with responses included that reflect the three pillars of sustainability.

- Strengthen the farming community (Social pillar)
- Assist farm families (Social pillar)
- Local economic development (Economic pillar)
- Monetary/Financial (Economic pillar)
- Improved environmental conditions (Environmental pillar)
- Nature conservation (Environmental pillar)
- Competitiveness/Productivity (Economic pillar)

From the responses we do not intend to develop an overall integrative numerical measure of "contribution to sustainability" for each demonstration activity. However, what we can explore is whether sustainability measures are important motivators behind demonstration activities and which ones are most important.

An important role of the sustainability framework presented here will be to provide a common vision for all members of the PLAID project to apply when assessing sustainability issues in the case studies. This involves a number of key concepts. In many studies the focus of "sustainability" in agriculture continues to fall on environmental sustainability (Gaviglio et al., 2016). Ensuring that research teams explore sustainability across all pillars in the case studies will play an important role in ensuring compatibility and quality of information gained. An additional important concept is the common understanding that agricultural sustainability occurs at the farm system level. This is particularly relevant for case studies where measures are taken to assess the impact of the demonstration activity on the uptake of innovation for sustainable agriculture.

7 Beyond demonstration: Upscaling from the multi-level perspective

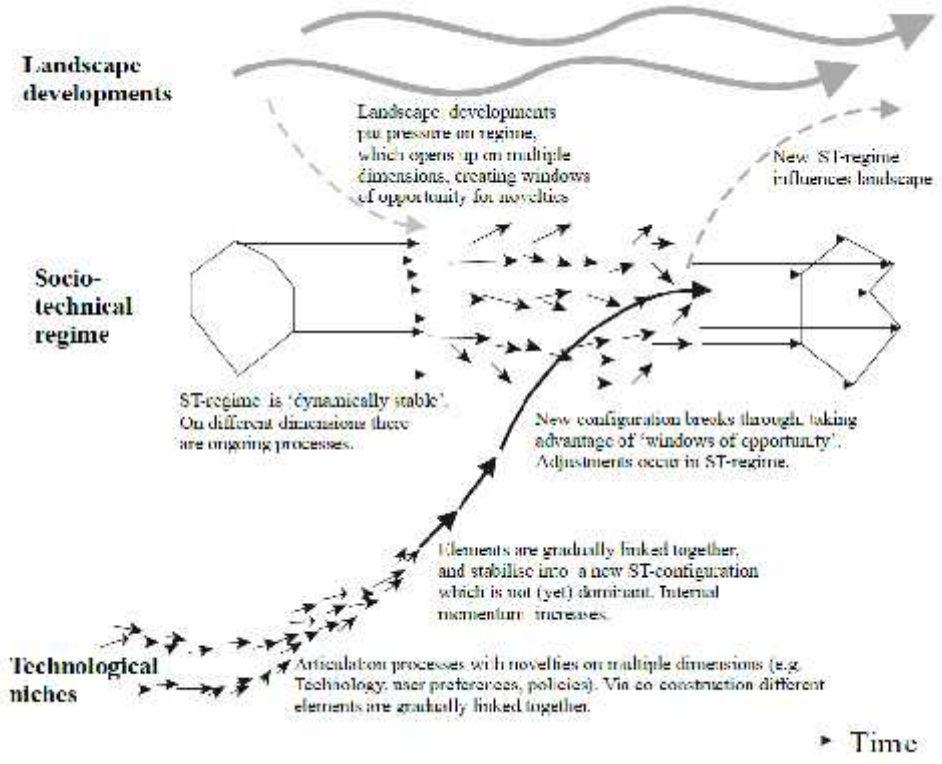
7.1 The multi-level perspective

The multi-level perspective (MLP) has been developed to analyse the dynamic of innovation processes, more specifically of 'radical' innovations (Rip and Kemp, 1998; Geels, 2002). These are distinguished from 'incremental innovations' that typically have a technical focus with little change on the social or behavioural side, i.e. successive generations of cars. Radical innovations, by contrast, are also associated with major societal and behavioural changes, e.g. the development of mobile and smart phones that have radically changed how people gather information, behave and interact. Such 'radical' innovation processes are also called 'system innovations' or 'transitions' (e.g. Elzen et al. 2004).

The core of the MLP is that system innovations are shaped by interaction between three levels: the sociotechnical landscape, the socio-technical regimes and technological niches (figure ##). Sociotechnical systems are located at the meso-level of socio-technical regimes. These regimes indicate a set of shared rules that guide and constrain the actors within a production and consumption system in how they try to tackle various challenges they encounter. This typically leads to evolutionary patterns of innovation. The socio technical landscape is an exogenous environment of factors with a broader societal relevance like the need to reduce CO2 emissions. Technological niches are the breeding ground for radical innovations that initially poorly fit the regime.

In the MLP dynamic, system innovations develop as follows. A novelty emerges in a local practice and becomes part of a niche when a network of actors is formed that share certain expectations about the future success of the novelty, and are willing to fund and work on further development. Niches may emerge and develop partly in response to pressure and serious problems in an existing regime which can be either internal to the regime itself (such as animal welfare in industrial animal production) or come from the socio-technical landscape (e.g. the pressure to curb CO2 emissions which affects more than just the animal production sector). The further success of niche formation is on the one hand linked to processes within the niche (micro-level) and on the other hand to developments at the level of the existing regime (meso-level) and the socio-technical landscape (macro-level). Supported by actors willing to invest in the new concept (industries, R&D organisations, government) and initially protected from competition at the market place (e.g. through subsidies), the novelty is improved within the niche, broader networks are formed around it, and more is learned about directions for improvement and functions it may fulfil.

Figure 5: A dynamic multi-level perspective on system innovation (Geels 2005).



After some level of improvement of the technology, and after learning more about its potential, it may find its way in specific market applications, often typical segments that

exploit new functional characteristics of the technology and focus less on cost structures (e.g. organic food). Through further improvement, increasing reliability, and cumulated experiences and learning about functionalities and potential applications the technology can spread to other market niches and/or trigger expansion of market niches. Processes of rule formation also play an important role, such as the development of standards and regulations for the technology, and processes to reduce the mismatch of the emerging technology with the rules of the dominant regime. As it starts to compete on or with main markets, the novelty may transform or substitute the existing regime and thus trigger a system innovation or transition process.

This perspective allows for a very dynamic view on innovation processes as its application to a variety of historical cases has shown. These studies, however, tend to focus on the vicissitudes of a specific alternative technology to an existing system (e.g. sailing ships replacing steamships; Geels 2002) although the new technology does not simply diffuse but changes in the process. This works fine for retrospective studies but it is problematic to use as a heuristic in a 'learning and experimentation strategy' seeking to contribute to system innovation. We do not know which alternative developments will play a key role in the development towards sustainable agriculture. We need to acknowledge that 'innovation in action' is much messier than retrospective historical studies portray it (cf. e.g. Elzen et al. 2012).

Demonstrations are activities by which demonstrators seek to encourage farmers to adopt the agricultural novelty (i.e. a technology and/or practice) that is being demonstrated. In terms of the MLP, there are two possible situations, depending on the 'state of adoption' of the novelty:

- The novelty is not or hardly used in commercial practice (as part of regular farm activities). In this case the novelty is part of a socio-technical niche and the objective is to stimulate its uptake by regular farmers who are part of the regime.
- The novelty is already used by a subset of farmers in commercial practice. In this case the novelty is already part of the regime and the objective of the demo is to stimulate its wider use within the regime.

In both cases we are looking at a situation which has been conceptualised as "scaling agricultural innovations" that builds on the MLP (Wigboldus et al. 2016).

7.2 Scaling of agricultural innovations

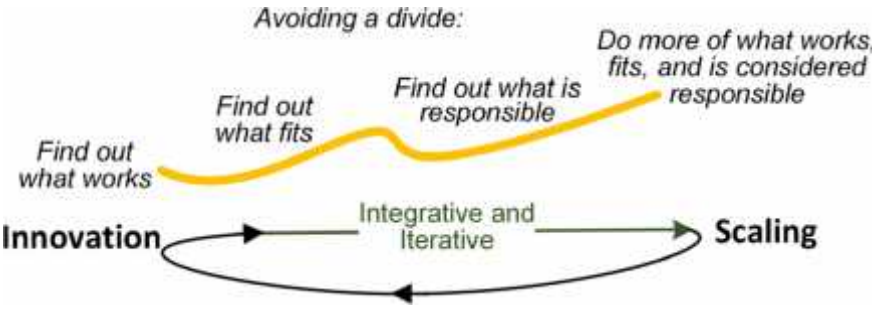
Scaling of innovations addresses the issue that has traditionally been conceptualised as transfer, dissemination, diffusion or adoption. The typical idea behind these concepts is that what has been demonstrated in one place can be copied elsewhere and work there as well. Recent work in innovation studies, however, is that this rarely works as simple as that. Especially in agriculture, with a broad variety of farming practices, a novelty needs further adaptation to be made to work in another location. Technologies and practices that work in a specific ecological, sociocultural or geographical area, do not automatically work, and may even have negative effects, in other areas. This may produce undesirable effects such as emission of pollutants and greenhouse gases, poorer animal welfare, deteriorating labour conditions, degradation of soil quality, etc. Finally, and not least important, in terms of policy adoption thinking focusses attention on the farm level while it neglects the importance of creating a conducive environment (e.g. by changing consumption behaviour, changing values of various stakeholders, changing markets and value chains, etc.).

To acknowledge this, scaling processes are conceptualised as an "integral part of a systemic approach to innovation, to anticipate on the possible consequences of scaling efforts" (Wigboldus et al. 2016, 1). Various authors make a distinction between scaling

up and scaling out (e.g. Anderson 2012; Millar and Connell 2010). Scaling up relates to the process of 'increase' (e.g. in terms of numbers, speed, size), whereas scaling out describes a process of 'expansion', e.g. geographical spread of a particular technology. Wigboldus et al. (2016) take these together, using the single term 'scaling'.

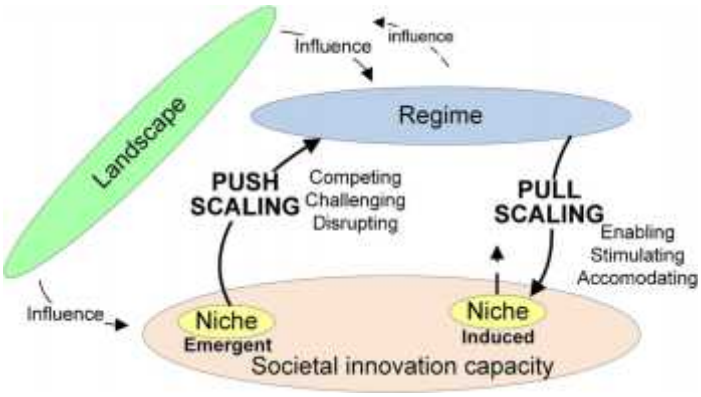
Scaling processes involve a complex dynamics that should not only be addressed in the latter stages, e.g. demonstration, dissemination or adoption stage, but also in early stages, i.e. the design and development of new technologies and practices to inform how they can be made to work in practice, rather than just on the drawing board. This implies that, rather than being the consequence of simple application of new technologies and practices that originated from successful research and innovation, scaling is embedded in a more continuous process involving a continuous process of adaptation and tuning (Fig. 6).

Fig. 6 : Scaling (up) as an integrative and iterative process (Wigboldus et al. 2016, 3).



Various innovation and scaling approaches and related policies and interventions can be distinguished, depending on situation specificities (Fig. 7). In the first approach (push), the value of the technology or practice (e.g. higher yielding crop variety) to be scaled up is taken for granted and the focus is on uptake and adoption. The second approach (pull) begins by defining a vision that innovation and associated scaling processes need to make a contribution to. The focus of activity is to reorient system values towards this vision, i.e. some players such as policymakers within the regime may assist niches to make changes and disrupt the regime (Kivimaa and Kern 2016; Mitchell et al. 2015)."

Fig. 7: Distinguishing different types of scaling initiatives in a simplified MLP view (Wigboldus et al. 2016, 10).



Historical studies largely provide examples of 'pushed scaling' whereas this also seems to be the main emphasis in current innovation attempts. However, 'pulled scaling' (support scaling by changing regime and niche conditions) may in many cases a more appropriate and effective approach.

7.3 Anchoring of innovations

Above, we distinguished two situations for the demonstrated novelty, viz. (1) the novelty is not or hardly used in commercial practice and (2) the novelty is already used by a subset of farmers in commercial practice. In both cases, the objective of the demonstration is to encourage the visiting farmers (i.e. regime actors) to start using the novelty in their own practice. In MLP terms, this process of creating a link between a novelty and a new set of actors is described as 'anchoring', more specifically as 'network anchoring' (Elzen et al. 2012).

To study the uptake of innovations, the concept of anchoring, which was developed in the context of system innovation programmes in the Netherlands (Loeber 2003, Grin & Van Staveren 2007). In a study of the uptake of radical energy novelties in glasshouse horticulture, the concept was defined more specifically as follows:

> "Anchoring is the process in which a novelty becomes newly connected, connected in a new way, or connected more firmly to a niche or a regime. The further the process of anchoring progresses, meaning that more new connections supporting the novelty develop, the larger the chances are that anchoring will eventually develop into durable links." (Elzen et al., 2012, p.3)

The concept of anchoring is defined such that it can take place in a niche, in a regime as well as between the two. This symmetric definition makes it particularly suited for the topic of demonstration where two situations are distinguished, depending on whether the novelty belongs to a niche or (already) to the regime. I both cases the concept of anchoring can be used to analyse its further vicissitudes.

Building on a distinction between three constituent components of a regime, notably technical, network and institutional components (Geels, 2004), the authors distinguish three forms of anchoring. These are technological anchoring, network anchoring and institutional anchoring (Elzen et al., 2012, p.4-6). Technological anchoring takes place when the technical characteristics of a novelty (e.g. new technical concepts) become defined by the actors involved and, hence, become more specific to them. Network anchoring means that the network of actors that support the novelty changes, e.g. by enrolling new producers, users or developers. Institutional anchoring relates to the institutional characteristics of the novelty, i.e. the new rules that govern its further development and uptake. Institutional anchoring implies that developments within a niche or regime become translated into adapted or new rules that govern, at least temporarily, the activities of both niche and regime actors.

Since demonstration is about seeking to connect larger numbers of farmers to a novelty, it primarily targets network anchoring. To facilitate scaling, however, all three forms of anchoring need to occur (Elzen et al. 2012; Elzen and Bos 2016). Hence, to analyse the impact of demonstrations, we not only need to look at whether visiting farmers 'adopt' the novelty but also at whether further technological anchoring and institutional anchoring take place in the wider farming community and the farming regime at large.

8. References

ADAS (2008) An Investigation into the Role and Effectiveness of Scottish Monitor Farms. ADAS UK Ltd, Wolverhampton.

Aldy, J.E., Hrubovcak, J., Vasavada, U. (1998) The role of technology in sustaining agriculture and the Environment. Ecological Economics 26: 81–96

Altieri, M.A., Nicholls, C.I., Montalba, R. (2017) Technological Approaches to Sustainable Agriculture at a Crossroads: An Agroecological Perspective. Sustainability 9, 349; doi:10.3390/su9030349

Anderson, I. (2012) Scaling development results. A literature review and implications for Australia's aid program. AusAid, Canberra

Andersen, E., Elbersen, B., Godeschalek, F., Verhoog, D. (2007) Farm management indicators and farm typologies as a basis for assessments in a changing policy environment. Journal of Environmental Management 82: 353–362

Andrews, A.C., Clawson, R.A., Graming, B.M., Raymond, L. (2013): Why do farmers adopt conservation tillage? An experimental investigation of framing effects. Journal of Soil and Water Conservation 68 (6): 501-511

Anon (1818) Report presented to his Majesty the Emperor Alexander, by his Excellency the Count de Capo-D'Istria, on the Establishments of M. de Fellenberg at Hofwyl, in October 1814 (Translated from French). The Farmer's Magazine 19 (73), 51-57

Anon (1845a) The History of Agriculture. The Agricultural Magazine, May 1845 1 (3): 133-139

Anon (1845b) French Agriculture. The Agricultural Magazine, October 1845 2 (1): 1-4.

AWC and WRO (2013) Knowledge Transfer and Innovation Relating to the Wales Rural Development Plan & European Innovation Partnership 2014-2020. Arsyllfa Wledig Cymru & Wales Rural Observatory. Cardiff University, Cardiff.

Bachev, H. (2017) A Study on Sustainability of Unregistered Agricultural Holdings in Bulgaria. Annals of Agricultural & Crop Sciences 2 (1): 1022.

Baker and Associates (1998) Monitor Farm Programme Cost-Benefit Analysis Report Prepared for Meat New Zealand. Baker & Associates, Masterton.

Bailey, A. P., Garforth, C. J., Angell, B., Scott, T., Beedell, J., Beechener, S. and Rana, R. B. (2006) Helping farmers adjust to policy reforms through demonstration farms: lessons from a project in England. Journal of farm management 12(10): 613-625.

Beaudin, B.P., Jacoby, L., Quick, D. (1997) Promoting safe behavior: Theoretical foundations Professional Safety 42 (4): 29-32

Bellotti, B., Rochecouste, J.F. (2014) The development of Conservation Agriculture in Australia—Farmers as innovators. International Soil and Water Conservation Research 2 (1): 21-34

Bess, J. (2015) The Price of Pima Cotton: The Cooperative Testing and Demonstration Farm at Sacaton, Arizona, and the Decline of the Pima Agricultural Economy, 1907–1920. The Western Historical Quarterly 46 (2): 171-189.

Bezlepkina, I., Reidsma, P., Sieber, S., Helming, K. (2011) Integrated assessment of sustainability of agricultural systems and land use: Methods, tools and applications. Agricultural Systems 104: 105–109

Biggeman, B.C., Gray, A.W., Morehart, M.J., Baker, T.G., Wilson, C.A. (2007) A New U.S. Farm Household Typology: Implications for Agricultural . Review of Agricultural Economics 29 (4): 765–782

Bijnen, E.J. (1973): Cluster Analysis: Survey and Evaluation Techniques. Netherlands, Tilberg University Press.

Binder, C.R., Feola, G., Steinberger, J.K. (2010) Considering the normative, systemic and procedural dimensions in indicator-based sustainability assessments in agriculture. Environmental Impact Assessment Review 30: 71–81

Bock, B.B., van Huik, M.M., Prutzer, M., Kling-Eveillard, F., Dockes, A. (2007) Farmer's relationship with different animals: The importance of getting close to the animals. Case studies of French, Swedish and Dutch cattle, pig and poultry farmers. International Journal of Sociology of Food and Agriculture 15 (3): 108-125

Bohnet, I.C., Roberts, B., Harding, E., Haug, K.J., 2011. A typology of graziers to inform a more targeted approach for developing natural resource management policies and agricultural extension programs. Land Use Policy 28, 629–637.

Bolis, I., Morioka, S.N., Sznelwar, L.I. (2014) When sustainable development risks losing its meaning. Delimiting the concept with a comprehensive literature review and a conceptual model. Journal of Cleaner Production 83: 7-20

Brandth, B. and G. Overrein (2013) Resourcing children in a changing rural context: fathering and farm succession in two generations of farmers. Sociologia Ruralis 53 (1): 95–111

Brodt, S., Klonsky, K., Tourte, L. (2006) Farmer goals and management styles: implications for advancing biologically based agriculture. Agricultural Systems 89, 90–105.

Buchholz, M., Holst, G., Musshoff, O. (2016) Irrigation water policy analysis using a business simulation game. Water Resources Research 52, 7980–7998.

Buckwell, A., Heissenhuber, A., Blum, W. (2014) The sustainable intensification of European agriculture. A review sponsored by the rise foundation. http://www.risefoundation.eu/images/files/2014/2014_%20SI_RISE_FULL_EN.pdf

Burton, R. (1998) The role of farmer self-identity in agricultural decision making in the Marston Vale Community Forest. Unpublished PhD Thesis (Leicester: DeMontfort University)

Burton, R.J.F. (2004) Seeing through the 'good farmer's' eyes: towards developing an understanding of the social symbolic value of 'productivist' behaviour. Sociologia Ruralis 44 (2): 195-216.

Burton, R.J.F. (2012) Understanding Farmers' Aesthetic Preference for Tidy Agricultural Landscapes: A Bourdieusian Perspective, Landscape Research, 37 (1): 51-71

Burton, R.J.F., Kuczera, C., Schwarz, G. (2008) Exploring farmers' cultural resistance to voluntary agri-environmental schemes. Sociologia Ruralis 48 (1): 16-37.

Burton, R., Wilson, G. (2006) Injecting social psychology theory into conceptualisations of agricultural agency: towards a 'post-productivist' farmer self-identity. Journal of Rural Studies 22 (1): 95-115.

Carpenter, C.J. (2015) A Meta-Analysis of the ELM's Argument Quality × Processing Type Predictions. Human Communication Research 41: 501–534

Clark, D.A. (2010) Contribution of farmlet scale research in New Zealand and Australia to improved dairy farming systems. Proceedings of the 4th Australasian Dairy Science Symposium 2010: 112-124.

Clavel, L., Soudais, J., Baudet, D., Leenhardt, D. (2011) Integrating expert knowledge and quantitative information for mapping cropping systems. Land Use Policy 28: 57–65

Cocklin, C., Mautner, N., Dibden, J., (2007) Public policy, private landholders: Perspectives on policy mechanisms for sustainable land management. Journal of Environmental Management 85, 986-998.

Cohen, A.P., 1985. The Symbolic Construction of Community. London, Routledge.

Collier, A; Cotterill, A; Everett, T; Muckle, R; Pike, T and Vanstone, A. (2010) Understanding and influencing behaviours: a review of social research, economics and policy making in Defra. http://library.college.police.uk/docs/defra/Understanding-influencing-behaviours-2010.pdf

Cook, A. (2014) The gift of good, vacant land: Urban agriculture and redevelopment in the city of Baltamore. Masters dissertation, Massachusetts Institute of Technology.

Crano, W., Prislin, R. (2006). Attitudes and persuasion. Annual Review of Psychology 57, 345-374

Dalglu, I., Nassauer, J.I., Riolo, R.L., Scavia, D. (2014) Development of a farmer typology of agricultural conservation behaviour in the American Corn Belt. Agricultural Systems 129: 93-102.

Darnhofer, I., Gibbon, D., Dedieu, B. (2012) Farming Systems Research: an approach to inquiry (in Ika Darnhofer, David Gibbon, and Benoit Dedieu, Eds.) Farming Systems Research into the 21st Century: The New Dynamic. Springer, London. P. 3-33.

Davies, B.B.; Hodge, I.D. (2007) Exploring environmental perspectives in lowland agriculture: A Q methodology study in East Anglia, UK. Ecological Economics 61: 323-333.

Delgado, A.H., Norby, B., Dean, W.R., McIntosh, W.A., Scott, M. (2012) Utilizing qualitative methods in survey design: Examining Texas cattle producers' intent to participate in foot-and-mouth disease detection and control. Preventive Veterinary Medicine 103: 120– 135

Dockes, A.C., Kling-Eveillard, F. (2006) Farmers' and advisers' representations of animals and animal welfare. Livestock Science 103: 243– 249

Driessen, C., Heutinck, L.F.M. (2015) Cows desiring to be milked? Milking robots and the co-evolution of ethics and technology on Dutch dairy farms. Agriculture and Human Values 32: 3–20

Drummond, I., Campbell, H., Lawrence, G., Symes, D. (2000) Contingent or Structural Crisis in British Agriculture? Sociologia Ruralis 40 (1): 111-127

Dwyer, J., Mills, J., Ingram, J. Taylor, J., Burton, R., Blackstock, K., Slee, B., Brown, K., Schwarz, G., Matthews, K., Dilley, R. (2007) Understanding and influencing positive behaviour change in farmers and land managers - a project for Defra. Final report, 30 November 2007. CCRI, Cheltenham.

EC (1999) Directions towards sustainable agriculture. Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions. Brussels, 27.01.1999 COM (1999) 22 final

EC (2012) Sustainable agriculture for the future we want. EU, Brussels.

EC (2015) Technical Handbook on the Management and Evaluation Framework of the Common Agricultural Policy 2014-2020. Directorate-General for Agriculture and Rural Development. Available at: http://ec.europa.eu/transparency/regexpert/index.cfm?do=group Detail.groupDetailDoc&id=21095&no=3

Egoz, S., Bowring, J., Perkins, H. (2001) Tastes in tension: form, function, and meaning in New Zealand's farmed landscapes. Landscape and Urban Planning 57: 177-196.

Ellis, W. (1743) The Modern Husbandman For the Month of October. Osborne & Cooper, London.

Elmquist, H., Krysztoforski, M. (2015) Using demonstration farms for a healthier Baltic sea. Report of the Baltic Deal Bridge project (funded by the Swedish Institute). http://www.balticdeal.eu/

Elzen, B., . Geels, F.W., Green, K. (eds.). (2004) System Innovation and the Transition to Sustainability, Cheltenham: Edward Elgar Publishing Ltd..

Elzen, B., Leeuwis, C., van Mierlo, B. (2012) Anchoring of Innovations: Assessing Dutch efforts to harvest energy from glasshouses. Environmental Innovation and Societal Transitions (5): 1-18.

Elzen, B., Bos, B. (2016) The RIO approach: Design and anchoring of sustainable animal husbandry systems, Technological Forecasting and Social Change. http://dx.doi.org/10.1016/j.techfore.2016.05.023

Evenson, R. (1998) The economic contributions of agricultural extension to agricultural and rural development. In: Improving agricultural extension. A reference manual, B. E. Swanson,

R. P. Bentz, A. J. Sofranko (Eds.), Food and Agriculture Organization of the United Nations, Rome. Available at: http://www.fao.org/docrep/w5830e/w5830e06.htm#chapter%204% 20the%20economic%20contributions%20of%20agricultural%20extension%20to%20agri cultural

Faber, N., Jorna, R., van Engelen, J. (2014) The sustainability of «sustainability" – a study into the conceptual foundations of the notion of "sustainability". Journal of Environmental Assessment Policy and Management 7 (1): 1–33

Farmar-Bowers, Q., Lane, R. (2009) Understanding farmers' strategic decision-making processes and the implications for biodiversity conservation policy. Journal of Environmental Management 90: 1135–1144.

Farmer, J.R., Chancellor, C., Fischer, B.C. (2011) Motivations for using Conservation Easements as a Land Protection Mechanism: A Mixed Methods Analysis. Natural Areas Journal 31 (1): 80-87

Fishbein, M.; Ajzen, I. (1975): Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research. Reading M.A., Addison-Wesley.

Frater, P., Franks, J. (2013) Measuring agricultural sustainability at the farm-level: A pragmatic approach. International Journal of Agricultural Management 2 (4): 207-225

Fulton, A., Fulton, D., Tabart, T., Ball, P., Champion, S., Weatherley, J., Heinjus, D. (2003) Agricultural extension, learning and change. A report for the Rural Industries Research and Development Corporation. Available at: https://rirdc.infoservices.com.au/downloads/03-032.pdf

Gandhi, R., Veeraraghavan, R., Toyama, K., Ramprasad, V. (2009) Digital Green: Participatory video and mediated instruction for agricultural extension. Information Technologies and International Development 5(1): 1-15.

Garforth C., Angell, B., Archerc, J., Green, K. (2003) Fragmentation or creative diversity? Options in the provision of land management advisory services. Land Use Policy 20: 323–333

Garforth, C., McKemey, K., Rehman, T., Tranter, R., Cooke, R., Park, J., Dorward, P., Yates, C. (2006) Farmers' attitudes towards techniques for improving oestrus detection in dairy herds in South West England. Livestock Science 103: 158–168.

Gaspar, P., Escribano, M., Mesías, F.J., Rodriguez de Ledesma, A., Pulido, F. (2008) Sheep farms in the Spanish rangelands (dehesas): Typologies according to livestock management and economic indicators. Small Ruminant Research 74: 52–63.

Gasson, R. (1973) Goals and values of farmers. Journal of Agricultural Economics 24: 521-537

Gasson, R.; Hill, P. (1990) An Economic Evaluation of the Farm Woodland Scheme, Department of Agricultural Economics, Wye College, Farm Business Unit Occasional Paper No. 17.

Geels, F.W. (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Research Policy 31 (8/9): 1257–1274.

Geels, F.W. (2004) From sectoral systems of innovation to socio-technical systems; Insight about dynamics and change form sociology and institutional theory. Research Policy (33): 897-920.

Geels, F.W. (2005) Technological Transitions and System Innovations: A co-evolutionary and socio-technical analysis. Edward Elgar Publishing Ltd., Chtenham.

Grin, J., van Staveren, A. (2007) Werken aan Systeeminnovaties (Working on System Innovations). Van Gorcum, Assen.

Gurevitch, J., Fox, G.A., Wardle, G.M., Inderjit, Taub, D. (2011) Emergent insights from the synthesis of conceptual frameworks for biological invasions. Ecology Letters 14: 407–418.

Haug, R. (1999) Some leading issues in international extension: A literature review. Journal of Agricultural Education and Extension 5(4): 263-274.

Heiniger, R. W., Havlin, J. L., Crouse, D. A., Kvien, C., Knowles, T. (2002) Seeing is believing: The role of field days and tours in precision agriculture education. Precision Agriculture 3(4): 309-318.

Hallam, A., Bowden, A., Kasprzyk, K. (2012) Agriculture and Climate Change: Evidence on Influencing Farmer Behaviours. Scottish Government social Research Series, Edinburg.

Hancock, J. (1997) Extension education: Conducting effective agricultural demonstrations. Cooperative Extension Service. University of Kentucky, College of Agriculture. Available at: http://www2.ca.uky.edu/agcomm/pubs/id/id111/id111.pdf

Hansen, J.W. (1996) Is Agricultural Sustainability a Useful Concept? Agricultural Systems 50: 117- 143

Hansen, B.G. (2015) Robotic milking-farmer experiences and adoption rate in Jæren, Norway. Journal of Rural Studies 41: 109-117

Hassell, T. and Cary, J. (2007). Promoting Behavioural Change in Household Water Consumption: Literature Review for Smart Water Project, Australia, 2007.

Haug, R. (1999) Some leading issues in international extension: A literature review. Journal of agricultural education and extension, 5(4): 263-274.

Higgins, V., Kitto, S. (2004) Mapping the dynamics of new forms of technological governance in agriculture: methodological considerations. Environment and Planning A 36: 1397-1410

Hilden, M., Jokinen, P., Aakkula, J. (2012) The Sustainability of Agriculture in a Northern Industrialized Country—From Controlling Nature to Rural Development. Sustainability 2012, 4, 3387-3403

Hill, B., Bradley, D., Williams, E. (2017) Evaluation of knowledge transfer; conceptual and practical problems of impact assessment of Farming Connect in Wales. Journal of Rural Studies 49: 41-49.

Hofstee,E.W. (1946), Over de oorzaken van de verscheidenheid in de Nederlandse landbouwgebieden, Rijksunversiteit Groningen, Groningen, the Netherlands (1946).

House of Commons (2011) Farming in the Uplands: Third Report of Session 2010–11. The Stationary Office Linited, London.

Iraizoz, B.; Gorton, M.; Davidova, S. (2007) Segmenting farms for analysing agricultural trajectories: A case study of the Navarra region in Spain. Agricultural Systems 93: 143–169

Jackson, T. 2005. Motivating Sustainable Consumption: A review of evidence on consumer behaviour and behaviour change. Report to the Sustainable Development Research Network. Centre of Environmental Strategy, University of Surrey. Guilford, Surrey.

Jabareen, Y. (2009) Building a Conceptual Framework: Philosophy, Definitions, and Procedure. International Journal of Qualitative Methods 8: 49-62.

Jansen, J., Renes, R.J., Lam, T.J. (2010) Evaluation of two communication strategies to improve udder health management. Journal of Dairy Science 93 (2): 604-12.

Johnson, W., Shaw, W. (1842). Whitfield Example Farm. The Farmer's Almanac and Calendar. Advertising sheet. 11-12.

Josefsson, J., Lokhorst, A.M., Pärt, T., Berg, Å., Eggers S (2017) Effects of a coordinated farmland bird conservation project on farmers' intentions to implement nature conservation practices - Evidence from the Swedish Volunteer & Farmer Alliance. Journal of Environmental Management 187: 8-15.

Kaljonen, M. (2006) Co-construction of agency and environmental management. The case of agri-environmental policy implementation at Finnish farms. Journal of Rural Studies 22: 205–216.

Kania, J., Kiełbasa, B. (2015) Demonstration farms for transfer of knowledge – Case study of Poland. Scientific journal 17 (5): 123-130.

Keeney, D.R. (1994) Sustainable agriculture and sustainable development: at the crossroads. International Fertiliser Development Center, Alabama.

Kenny, G., 2011. Adaptation in agriculture: lessons for resilience from eastern regions of New Zealand. Climatic Change 106, pp. 441–462.

Kittrell, B.U. (1974) Result demonstration technique – history, philosophy, and contemporary nature. Paper number 138 of the Journal Series of the North Carolina State University Agricultural Extension Service, Raleigh, North Carolina.

Kivimaa, P., Kern, F. (2016) Creative destruction or mere niche support? Innovation policymixes for sustainability transitions. Research Policy 45: 205–217

Kizos, T., Kristensen, L.S. (2011) The 'good farmer': Studies of farm management practices and landscape change. Geografisk Tidsskrift-Danish Journal of Geography 111(2): 105-106

Kudsh, P., Jenkens, J.E. (2014) Experiences with Implementation and Adoption of Integrated Pest Management in Denmark. In R Peshin & D Pimentel (eds), Integrated Pest Management: Experiences with Implementation, Global Overview. vol. 4, Springer, London.

Kudsk, P., Jensen, J.E. (2014) Experiences with Implementation and Adoption of Integrated Pest Management in Denmark.

Kueper AM, Sagor ES, Becker DR (2013). Learning from landowners: examining the role of peer exchange in private landowner outreach through landowner networks. Society and Natural Resources 26: 912–930.

Kuhlman, T., Farrington, J. (2010) What is Sustainability? Sustainability 2: 3436-3448

Kurz, P. (2013) Management Strategies and Landscape Diversity in Commonly Governed Mountain Pastures: A Case Study from Austrian Alps. European Countryside 5 (3): 212-231.

Knapp, S.A. (1909) The farmer's cooperative demonstration work. Yearbook of the Department of Agriculture 1909: 153-160.

Knapp, B. (1916) Education through farm demonstration. The Annals of the American Academy of Political and Social Science 67(1): 224-240.

Kroeber, A.L., Kluckhohn, C., 1952. Culture: A Critical Review of Concepts and Definitions. The Museum, Cambridge, Massachusetts.

La Grange R. F., Titterton, M., Mann, E. M., Haynes, C. M. (2010) Agricultural extension: A review and case study in the Tasmanian dairy farming sector. In: Proceedings of the 4th Australasian Dairy Science Symposium 2010: 261-264.

Lehman, D.R., Chiu, C., Schaller, M. (2004) Psychology and culture. Annual Review of Psychology 44: 689-714.

Leeuwis, C. (2004) Communication for Rural Innovation: Rethinking Agricultural Extension. 3rd edition. Blackwell Publishing.

Loeber, A. (2003) Inbreken in het gangbare: Transitiemanagement in de praktijk – De NIDO benadering (Breaking in into the Usual: Transition Management in Practice – The NIDO Approach). NIDO, Leeuwarden.

Leonard, P.L., Cobham, R.O (1977) The farming landscapes of England and Wales: a changing scene. Landscape Planning 4: 205-236.

Louden, J.C. (1825) An Encyclopedia of Agriculture. Longman & Co., London.

Lukuyu, B., Place, F., Franzel, S., Kiptot, E. (2012) Disseminating improved practices: Are volunteer farmer trainers effective? Journal of Agricultural Education and Extension 18(5): 525-540.

Madsen, L.M. and Adriansen, H.K. (2004) Understanding the use of rural space: the need for multi-methods. Journal of Rural Studies 20 (4), 485-497

Magill, K. P. & Rogers E.M. (1981) Federally sponsored demonstrations of technological innovations. Knowledge: Creation, Diffusion, Utilization 3(1): 23-42.

Maheswaran, D., Meyers-Levy, J. (1990) The influence of message framing and issue involvement. Journal of Marketing Research (27): 361–371

Malalgoda, C., Amaratunga, D., Haigh, R. (2016) Local governments and disaster risk reduction: a conceptual framework. In: Proceedings of the 6th International Conference on Building Resilience. Massey University / The University of Auckland, Auckland, New Zealand.

Manstead, A.S.R. (2011) The benefits of a critical stance: A reflection on past papers on the theories of reasoned action and planned behaviour. British Journal of Social Psychology 50: 366–373.

Marshall, G.R. (2004) From words to deeds: enforcing farmers'conservation cost-sharing commitments. Journal of Rural Studies 20: 157–167

Martin, O.B. (1921) The Demonstration Work - Dr. Seaman A. Knapp's Contribution to Civilization. The Stratford Co., Boston.

Mead, W.R. (2003) Pehr Kalm: a Finnish visitor to the Chilterns in 1748. Aston Clinton: privately published by the author: 160 pages.

Mease, J. (1818) Address on the subject of establishing a pattern farm in the vicinity of Philadelphia. Philadelphia Society for Promoting Agriculture, Philadelphia.

Meul, M., Van Passel, S., Nevens, F., Dessein, J., Rogge, E., Mulier, A., & Van Hauwermeiren, A.

(2008). MOTIFS: A monitoring tool for integrated farm sustainability. Agronomy for

Sustainable Development, 28 , 321–323.

Meert, H. Van Huylenbroeck, G.; Vernimmenc, T.; Bourgeoisa, M.; van Hecke, E. (2005) Farm household survival strategies and diversification on marginal farms. Journal of Rural Studies 21: 81–97

McDowell, M. S. (1929) What the agricultural extension service has done for agriculture. The Annals of the American Academy of Political and Social Science 142(1): 250-256

Millar, J., Curtis, A. (1997) Moving farmer knowledge beyond the farm gate: An Australian study of farmer knowledge in group learning. European Journal of Agricultural Education and Extension 4(2): 133-142

Millar, J., Connell, J. (2010) Strategies for scaling out impacts from agricultural systems change: the case of forages and livestock production in Laos. Agriculture and Human Values 27: 213–225

Mitchell, C., Cordell, D., Fam, D. (2015) Beginning at the end: the outcome spaces framework to guide purposive transdisciplinary research. Futures 65: 86–96

Molas-Gallart, J. & Davies, A. (2006) Toward Theory-Led Evaluation: The Experience of European Science, Technology, and Innovation policies. American Journal of Evaluation 27(1): 64-82

Morgan-Davies, C., Waterhouse, T., Wilson, R. (2011) Characterisation of farmers' responses to policy reforms in Scottish hill farming areas. Small Ruminant Research 102 (2): 96-107.

Morris, C., Evans, N., 2004. Agricultural turns, geographical turns: retrospect and prospect. Journal of Rural Studies 20 (1), 95-111

Morton, L.W., McGuire, J.M., Cast, A.D. (2017) A good farmer pays attention to the weather. Climate Risk Management 15: 18–31

Murphy, A. (2014) Innovation adoption and farm management practices in the Canterbury dairy industry. Masters thesis, Lincoln University, NZ.

Murphy, K. (2012) The social pillar of sustainable development: a literature review and framework for policy analysis. Sustainability: Science, Practice, & Policy 8 (1): 15-29

Musshoff, O. Hirschauer, N. (2014) Using business simulation games in regulatory impact analysis – the case of policies aimed at reducing nitrogen leaching. Applied Economics 46 (25): 3049-3060

Ojalehto, B.I., Medin, D.L. (2015) Perspectives on Culture and Concepts. Annual Review of Psychology 66: 249-75.

Opara, U. N. (2008) Agricultural information sources used by farmers in Imo State, Nigeria. Information Development 24(4): 289-295.

O'Keefe, D.J. (2002) Persuasion: Theory and Research (2nd ed.). Sage Publicaitons, London.

O'Rourke, E., Kramm, N., Chisholm, N. (2012) The influence of farming styles on the management of the Iveragh uplands, southwest Ireland. Land Use Policy 29: 805– 816.

Oyserman , D. (2017) Culture Three Ways: Culture and Subcultures Within Countries. Annual Review of Psychology 68:435-463

Pacini, G.C., Coulucci, D., Baudron, F., Right, E., Corbeels, M., Tittonell, P., Stefanini, F.M. (2014) Combining multi-dimensional scaling and cluster analysis to describe the diversity of rural households. Expl Agric 50 (3): 376-397.

Pangborn, M.C. (2012) Growth and Innovation in the Canterbury Dairy Industry. PhD Thesis, Lincoln University, NZ.

Pangborn, M.C., Woodford, K.B., Nuthall, P.L. (2011) Demonstration farms and technology transfer: the case of the Lincoln University dairy farm. International Journal of Agricultural Management, Volume 1 Issue 1: 29-33.

Peluso, A.M. (2015) Psychological drivers in the adoption of morally controversial innovations: the moderating role of ethical self-identity. Business Ethics: A European Review 24 (3): 252-263.

Pretty, J.N. (1994) Alternative systems of inquiry for a sustainable agriculture. IDS Bulletin 25 (2): 37-49

Petty, R.E., Brinol, P. (2014) The Elaboration Likelihood and Metacognitive Models of Attitudes Implications for Prejudice) the Self and Beyond. In J. W. Sherman, B. Gawronski, & Y. Trope. (Eds.). Dual-process theories o/the social mind (pp. 172-187). New York: NY: Guilford Press.

Petty, R.; Cacioppo, J. (1986). The Elaboration Likelihood Model of persuasion. Advances in Experimental Scoial Psychology, 19: 123-205.

Petty, R.E., McMichael, S., Brannon, L.A. (1992) The Elaboration Likelihood Model of Persuasion: Applications in Recreation and Tourism. In Manfredo, M. J. (Ed.) Influencing Human Behavior: Theory and applications in recreation, tourism, and natural resources management. Champaign, IL: Sagamore Publishing. Pages 78-101

Pomeroy, W.T. (1794) General view of the agriculture of the county of Worcester. Millan, London.

Poudel, D., Sthapit, B., Shrestha, P. (2015) An Analysis of Social Seed Network and Its Contribution to On-Farm Conservation of Crop Genetic Diversity in Nepal. International Journal of Biodiversity 2015, Article ID 312621, 13 pages

Rasul, G., Thapa, G.B. (2004) Sustainability of ecological and conventional agricultural systems in Bangladesh: an assessment based on environmental, economic and social perspectives. Agricultural Systems 79: 327–351

Rehman, T., McKemey, K., Yates, C.M., Cooke, R.J., Garforth, C.J., Tranter, R.B., Park, J.R., Dorward, P.T. (2007) Identifying and understanding factors influencing the uptake of new technologies on dairy farms in SW England using the theory of reasoned action. Agricultural Systems 94: 281–293

Rhodes, A.P., Aspin, M.D. (1993) MRDC monitor farms – using information. Proceedings of fhe New Zealand Grassland Association 55: 23-26

Rip, A., Kemp, R. (1998) Technological Change. In S. Rayner and E.L. Malone (eds), Human Choice and Climate Change. Columbus, Ohio: Battelle Press. Volume 2: pages 327-399.

Ripoll-Bosch, R., Díez-Unquera, B., Ruiz, R., Villalba, D., Molina, E., Joy, M., Olaizola, A., Bernués, A., (2012) An integrated sustainability assessment of Mediterranean sheep farms with different degrees of intensification. Agricultural Systems 105 (1), 46–56

Roderick, D., Cook, J., Morris, D., Francis, J., Davies, O., McCalman, H., and Hitchings, R. (2000) Demonstration Farm Network Review and Analysis ADAS and Welsh Institute of Rural Studies Report for Lantra and WDA.

Ryan, M., Hennessy, T., Buckley, C., Dillon, E.J., Donnellan, T., Hanrahan, K., Moran, B. (2016) Developing farm-level sustainability indicators for Ireland using the Teagasc National Farm Survey. Irish Journal of Agricultural and Food Research 55 (2): 112-126

Sardain, A., Tang, C., Potvin, C. (2016) Towards a dashboard of sustainability indicators for Panama : A participatory approach. Ecological Indicators 70: 545–556

Saugeres, L. (2002): The cultural representation of the farming landscape: masculinity, power and nature. Journal of Rural Studies 18, 373-384.

Scheifer, J., Loira, G.J., Blum, W.E.H. (2016) Potential and limits of land and soil for sustainable intensification of European agriculture. Agriculture, Ecosystems and Environment 230 (2016) 283–293

Schmitzberger, I., Wrbka, Th., Steurer, B., Aschenbrenner, G., Peterseil, J. and H.G. Zechmeister (2005) How farming styles influence biodiversity maintenance in Austrian agricultural landscapes. Agriculture, Ecosystems and Environment 108 pp. 274–290

Schot, J., Geels, F.W. (2008) Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technology Analysis & Strategic Management 20 (5): 537-554

Seghezzo, L. (2009) The five dimensions of sustainability, Environmental Politics 18 (4): 539-556

Slater, M.D. (2006) Specification and Misspecification of Theoretical Foundations and Logic Models for Health Communication Campaigns. Health Communication 20 (2): 149-157

Smallshire, D., Robertson, P., Thompson, P. (2004) Policy into practice: the development and delivery of agri-environment schemes and supporting advice in England. Ibis 146 (Suppl. 2): 250–258

Sneddon, J., Soutar, G., Mazzarol, T. (2002) Modelling the faddish, fashionable and efficient diffusion of agricultural technologies: A case study of the diffusion of wool testing technology in Australia. Technological Forecasting & Social Change 78: 468–480

Soini, K., Aakkula, J., 2007. Framing the biodiversity of agricultural landscape: The essence of local conceptions and constructions. Land use policy 24 (2): 311-321.

Soini, K., Birkeland, I. (2014) Exploring the scientific discourse on cultural sustainability. Geoforum 51: 213–223.

Stewart, P., Harding, D., Day, E. (2002) Regulating the new agricultural biotechnology by managing innovaiton diffusion. American Review of Public Administration 32 (91): 78-99.

Strand, K., Arnould, E., Press, M. (2014) Tillage practices and identity formation in High Plains farming. Journal of Material Culture 19(4): 355–373

Sutherland, L-A.; Burton, R.J.F.; Ingram, J.; Blackstock, K.; Slee, B. (2012) Triggering Change: Towards a conceptualisation of major change processes in farm decision-making. Journal of Environmental Management 104, 142-151.

Swanson, B.E.; Rajalahti, R. (2010). Strengthening Agricultural Extension and Advisory Systems : Procedures for Assessing, Transforming, and Evaluating Extension Systems. Agriculture and Rural Development Discussion Paper;No. 45. World Bank, Washington, DC.

Tait, J., Morris, D. (2000) Sustainable development of agricultural systems: competing objectives and critical limits. Futures 32: 247–260

Tarnoczi, T.J., Berkes, F. (2010) Sources of Information for Farmers' Adaptation Practices in Canada's Prairie Agro-Ecosystem, Climate Change 98 (1-2): 299-305.

Teschner, N., Orenstein, D.E., Shapira, I., Keasar, T. (2017) Socio-ecological research and the transition toward sustainable agriculture, International Journal of Agricultural Sustainability 15 (2): 99-101

The Committee appointed to consider the Petition of the Wester Ross Farming Society (1841) Experimental Farm. The Farmer's Magazine 14 (2), 85-89.

The Journal of the Bath and West of England Society of Agriculture, Arts, Manufactures, and Commerce (1855) Introduction. James Ridegway, London.

Tittonell, P. (2014) Ecological intensification of agriculture — sustainable by nature. Current Opinion in Environmental Sustainability 8 :53–61

Tormala, Z.K., Brinol, P., Petty, R.E. (2006) When credibility attacks: The reverse impact of source credibility on persuasion. Journal of Experimental Social Psychology 42: 684–691

True, C.A. (1928) A history of agricultural extension work in the United States 1785-1923. USDA Miscellaneous Publication no.15. 219 Pages.

Tsouvalis, J., Seymour, S. and C. Watkins. (2000) Exploring knowledge-cultures: precision farming, yield mapping, and the expert – farmer interface. Environment and Planning A 32: 909-924

USDA (1951) Soil Survey Manual. U. S. Dept. Agriculture Handbook No. 18. Government Printing Office, Washington D.C.

Valbuena, D.; Verburg, P.; Bregt, A. (2008) A method to define a typology for agent-based analysis in regional land-use research. Agriculture, Ecosystems and Environment 128: 27–36.

Vallance, S., Perkins, H.C., Dixon, J.E. (2011) What is social sustainability? A clarification of concepts. Geoforum 42: 342–348

Van Calker, K.J., Berentsen, P.B., Giesen, G.W., Huirnel, R.B.M. (2005) Identifying and ranking attributes that determine sustainability in Dutch dairy farming. Agriculture and Human Values 22: 53–63

Van der Ploeg, J.D. (1993): Rural sociology and the new agrarian question. Sociologia Ruralis, Vol. 33 (2): 240-260.

Van der Ploeg, J. (2003) The virtual Farmer: Past, Present and Future of Dutch Peasantry. Royal Van Gorcum, Assen.

van der Ploeg, J., Laurent, C., Blondeau, F., Bonnafous, P. (2009) Farm diversity, classification schemes and multifunctionality. Journal of Environmental Management 90: 124–131

Van Dijk, W.F.A., Lokhorst, A.M., Berendse, F., de Snoo, G.R. (2015) Collective agri-environment schemes: How can regional environmental cooperatives enhance farmers' intentions for agri-environment schemes? Land Use Policy 42:759–766

Van Dijk, W.F.A., Lokhorst, A.M., Berendse, F., de Snoo, G.R. (2016) Factors underlying farmers' intentions to perform unsubsidisedagri-environmental measures. Land Use Policy 59: 207-216.

Vaze, P. (1998) An economic analysis of tenure in East Anglia using qualitative data. Journal of Agricultural Economics 49, 443–457

Veisi, H. (2012) Exploring the determinants of adoption behaviour of clean technologies in agriculture: a case of integrated pest management. Asian Journal of Technology Innovation 20 (1): 67-82

Velten, S., Leventon, J., Jager, N., Newig, J. (2015) What Is Sustainable Agriculture? A Systematic Review. Sustainability 7: 7833-7865

Vennet, B.V., Schneider, S., Dessein, J. (2016) Different farming styles behind the homogenous soy production in southern Brazil, The Journal of Peasant Studies 43 (2): 396-418

Walster, E., Aronson, E., Abrahams, D. (1966) On increasing the persuasiveness of a low prestige communicator. Journal of Experimental Social Psychology 2 (4): 325-342

Warner, K. D. (2006) Extending agroecology: Grower participation in partnerships is key to social learning. Renewable Agriculture and Food Systems 21(2): 84-94.

Waters, W., Thomson, D., Nettle, R. (2009) Derived attitudinal farmer segments: A method for understanding and working with the diversity of Australian dairy farmers. Extension Farming Systems Journal 5 (2): 47-57.

Wauters, E., D'Haene, K.D., Lauwers, L. (2017) The social psychology of biodiversity conservation in agriculture. Journal of Environmental Planning and Management 60 (8): 1464-1484

WB (2000) Monitoring and Evaluation for AKIS Projects. The World Bank Rural Development Family Agricultural Knowledge & Information Systems (AKIS). Work in progress for public discussion. Prepared by Gary Alex and Derek Byerlee with inputs from the AKIS Thematic Team Framework and Options. Available at: http://siteresources.worldbank.org/INTARD/825826-1111400636162/20431913/monitoringandeval.pdf

WCED (1987). Our Common Future. World Commission on Environment and Development. Oxford University Press, Oxford.

Webby, R.W., Sheath, G.W. (1991) Group monitoring, a basis for decision making and technology transfer on sheep and beef farms. Proceedings of the New Zealand Grassland Association 53: 13-16

Weltin, M., Zasada, I., Franke, C., Piorra, A., Raggi, M., Viaggi, D. (2017) Analysing behavioural differences of farm households: An example ofincome diversification strategies based on European farm survey data. Land Use Policy 62: 172–184

Wigboldus, S., .Klerkx, L., Leeuwis, C., Schut, M., Muilerman, S., Jochemsen, H. (2016) Systemic perspectives on scaling agricultural innovations. A review. Agronomy for Sustainable Development 36 (46): 1-20

Witt, K., Givens, V.K., Peterson, T.R., Todd, J.D., Vallabhan, S., Becktold, M.G., Stephenson, M.T., Hyde, M.K., Plugge, C.D., Jarrett, R. (1993) Preventing tractor-related injuries and deaths in rural populations: using a persuasive health message framework in formative evaluation research. Quarterly Journal of Community Health Education 13 (3): 219-251.

Young, A. (1771) A six months tour through the North of England. Strahan & Co., London.

Zhou, M., Baozhou, L., Fan, W., Wang, G.A. (2016) Project description and crowdfunding success: an exploratory study. Information Systems Frontiers, pp 1–16. doi:10.1007/s10796-016-9723-1

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