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Towards sustainable European grassland farming with Inno4Grass: an infrastructure for innovation and knowledge sharing

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Abstract

European agriculture is facing tremendous challenges related to the rapid decrease in farm populations, competitiveness on open markets and the preservation of natural resources. Grasslands, which are highly significant for nature conservation often face land-use competition with arable cropping, urbanisation and other uses. Farmers need dedicated innovations to improve the economic performance of grasslands and their effective implementation in practice. This requires co-creation of knowledge between researchers and farmland practitioners, as was broadly pointed out by the European Commission. This paper describes a novel approach for creating a collaborative space for grassland innovations contributing to profitability of European grassland farms while preserving environmental benefits. Innovative modes of collaboration between practice and science are enabled by an international thematic network across eight European member states. A methodology that serves to collect farmers' innovative ideas and to stimulate collaboration among various stakeholders (farmers' groups, extension services, education and research) including cross-border collaborations, where grassland-related knowledge is made available for local conditions. This interactive innovation model fosters knowledge exchange and establishes a farmland-specific information management system. The aim is to stimulate a renewed, collaborative innovation culture for European Union (EU) grasslands. The methods are conceptualised and put into practice by the thematic network project Inno4Grass funded under Horizon 2020.

Keywords

Collaboration • European Innovation Partnership (EIP) • Inno4Grass • innovation • knowledge sharing • knowledge transfer

Introduction

Grasslands are vitally important for both agriculture and society. Permanent and temporary grasslands cover 61 million ha across the European Union (EU)-28 representing 16% of the total land area and 40% of the agricultural area in the EU (Eurostat, 2010 in: Osoro, 2014). These grasslands serve multiple functions, including local provision of fodder for animal husbandry (and hence high-quality food provision for citizens), biodiversity conservation, carbon storage and provision of "traditional" landscapes that European citizens appreciate for recreational purposes and cultural heritage (Silva, 2008; Huyghe *et al.*, 2014; Olsson *et al.*, 2014; Duru *et al.*, 2015; Ryals *et al.*, 2015). The large diversity of management practices, soils and climates enhances the range of ecosystem services provided by grasslands. A large share of European grasslands is exclusively used for animal feed and forms the basis for ruminant production as a significant component of European agriculture. The production of dairy, beef and sheep is of major economic importance to many member states; about 4.5 million farm enterprises held grazing livestock in the EU-28 in 2013 (Eurostat, 2014). The EU farmers often do not perceive the multi-functionality of grasslands as an advantage. This has resulted in an undervaluation and a lack of development strategies. Since market-oriented concepts to create rewards for ecosystem services have not yet been sufficiently developed or understood, their multi-functionality turns

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grasslands – especially in intensive production systems – increasingly into areas of conflict between food demand and calls for the provision of other ecosystem services.

The numerous economic and environmental benefits of grasslands (e.g. biodiversity, mitigation of climate change) can be further enhanced. This requires innovations in grasslands that provide benefits in both dimensions (Green *et al.*, 2005). Many EU farmers and farmers' associations are struggling to find solutions that would increase the contribution of grasslands in terms of economic added value and at the same time stimulate rural development, ecological and societal benefits such as biodiversity and healthy food production. Furthermore, over the last decades, non-grassland-based forms of livestock farming that are based on the intensive use of commercial (and often imported) feed have been less economically viable than many other sectors (e.g. arable production) in many European grassland areas (Huyghe *et al.*, 2014). The potential for better use of grassland to reduce production costs in livestock farming has also been underestimated. To ensure economic viability for farmers on the one hand, and the increasing pressure to reduce the environmental impact of farming on the other hand, farmers and the whole practice community need innovations.

The aim of this paper is to suggest a collaborative innovation model for grasslands in Europe. First, the political and theoretical frameworks for innovation and knowledge transfer (KT) and knowledge sharing are discussed. The EU project Inno4Grass (www.inno4grass.eu) is presented as an example of a conceptual framework that stimulates innovation through collaborative KT. Inno4Grass, a thematic network funded under Horizon 2020 (H2020), aims to bridge the gap between practice and science communities to ensure the implementation of innovative systems on productive grasslands, to increase the profitability of European grassland farms and to preserve environmental values.

Framework for innovation

The urgent need for innovations in agriculture has recently been emphasised by the European Commission (EC) (COM, 2010, 2020; COM 571 final, 2011; COM 79 final, 2012; OECD, 2017). Meeting the future demand for food from an increasing world population with less impact on natural resources on finite areas for production poses tremendous challenges for the entire agricultural sector. This requires a fundamental rethink of established best practices, in the EU and elsewhere. The EU's response to these challenges is being developed in the context of an overarching strategic policy orientation towards stimulating economic growth based on innovations, sustainability and smart and inclusive knowledge and learning systems (COM, 2010).

Innovations for grasslands need to consider the connection and potential trade-off between productivity and provision of public goods, in particular ecosystem services. Moreover, these connections and trade-offs are often context- and place-specific. Local land users and stakeholders often have relevant place-specific knowledge that is essential not only for implementation but can also form the basis of innovations and learning.

Although the need for innovations has been expressed, successful innovations can hardly be imposed. Sustainability-oriented innovation policy needs to create context conditions that stimulate the creation and diffusion of innovations that typically require multi-stakeholder collaboration. An innovation is an idea, practice or object that is perceived as new by an individual or other social unit of adoption (Rogers, 2003). The subjective novelty generates uncertainty and people will look for more information about the practicability and advantages of the innovation, but also its coherence with social norms and expectations (Rogers, 2003). The Organisation for Economic Co-operation and Development (OECD) defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace or external relations" (OECD, 2005). Horibe (2007) stated that innovations are more ambitious and should trigger a ground-breaking, category-shattering, revolutionary change in the way people see the world. Hence, those innovations may be rupture innovations in comparison to incremental innovations, where all components of a production system benefit from small steps of progress. One may assume that the latter might be more likely to be adopted by the actors of a social system. However, an accumulation of incremental change can lead to transformative change over time.

While "innovation" has often become synonymous to "product innovation", the term includes the introduction of novel services, management processes or organisational practices, and even social innovations (Mulgan, 2006), for example, micro-finance or community-supported agriculture. For the future development of grasslands, all types of innovations are likely to be essential. Social innovations that connect grassland use and ecosystem services to societal needs will also need to play an active role.

Rogers' (2003) work on innovation diffusion has been highly influential in shaping our understanding of innovation processes. Rogers conceives an innovation as a novel idea that has been generated outside a social system and which is then spread and adopted throughout the system through communication. The theory highlights the importance that an innovation is made accessible and that its effects can be observed to allow a judgement about its usefulness. From the farmers' perspective, it seems irrelevant whether an idea or solution is globally new or just new to him. For the farmer, it

is crucial that the novelty – whether globally new or already existing in another region – will be made accessible for him and works effectively and hence is an innovation for him. Adoption of innovations may be facilitated through different mechanisms that will increase rates of adoption (Arthur, 1994) and tackle path-dependency of established practices. Among those mechanisms, learning by doing or by using and direct network externalities (groups of farmers) have proven very effective (Arthur, 1994).

More recent work has emphasised that innovation processes are often not exogenous, but endogenous to social systems. Rather than conceptually separating the source of an innovation and the social system through which it spreads, the dominant line of innovation research has now adopted the concept of an "innovation system" (e.g. Nelson, 1993). National, regional or industry-specific networks of actors, rules and organisations determine the ability of a society to create and adopt innovations, but their interests, norms and skills also shape the direction of the innovation process. Often one actors' innovation also needs to align with innovations by others – an interdependence that has been characterised as "innovation ecosystem" (Adner, 2006).

Innovation processes in agricultural systems typically involve a wide range of actors, including researchers, farmers, advisors, agribusiness, retailers, non-profit organisations, etc. These innovation systems also interact strategically with their environment (Klerkx *et al*., 2010). Nevertheless, innovations are only successful when they have reached a broader acceptance, when they are disseminated and adopted within a social system such as rural communities, peer groups, regional networks, etc. (Planck & Ziche, 1979; Ouedraogo & Bertelsen, 1997). However, despite the more systemic approach to innovation systems, many gaps and deficits remain, for instance:

- often research is insufficiently linked to practice while scientific novelties/innovations stimulate limited practical innovations,
- many farmers are not well integrated into innovation systems, so their needs are not sufficiently considered during innovation generation,
- innovative ideas from practitioners are not easily captured and up-scaled, that is, local or practice-generated innovations with strong potential for dissemination are often not recognised (World Bank, 2006; EU SCAR, 2013).

Many innovation theories conceptualise collaboration and communication as a relationship between a source (or sender) and a receiver. Putting only such an asymmetrical relationship at the centre is problematic. The assumption of two distinct types of actors where the source or sender shares the knowledge and the receiver acquires the knowledge suppresses any vision of collaboration where every partner has something to contribute. Moreover, innovation in this context of "co-creation" is a complex process with various prerequisites, factors and contextual issues. Therefore, we see the term "knowledge sharing" as more adequate for the context of innovation than the term "knowledge transfer" which has become a broad research topic in social science.

Several reasons explain the low rate of innovations in grasslands:

(i) Grassland-based production systems are complex and diverse; therefore, innovative systems must be implemented as a combination of innovative practices with place-specific adaptations that are strongly dependent on local conditions, often amounting to "re-invention" (Rogers, 2003); the novel practice finally implemented is then a co-product of scientific and practitioner innovation.
(ii) Benefits from innovation on grasslands are often perceived only after considerable time lags.
(iii) Grassland innovations affect various aspects of sustainability (profitability, environment, social acceptance) and often in contradictory ways.
(iv) Limited interaction between farmers and research hampers context-specific re-invention.
(v) Grassland-related innovation systems are underdeveloped in comparison to those related to arable-land or animal production systems.

These observations have challenged established KT methods and structures and triggered calls for a socially attuned approach that considers interrelations, trust, power, social capital and networking. One line of thought has emphasised the co-creation of knowledge between scientists and different groups of practitioners and the role of knowledge brokers (Klerkx *et al.*, 2009). This approach sheds new light on the processes of KT. However, there is no blueprint for successful innovation processes and the influencing factors are manifold and situation-specific (Rogers, 2003).

In the following section, the most relevant aspects of KT and knowledge sharing for innovations and innovation management in grasslands are compiled and explained. The move from KT to knowledge sharing corresponds to the shift from innovation dissemination models to innovation system thinking. Based on these conceptual considerations, we then explain the methodology that has been drawn up for the Inno4Grass project, a thematic network funded under H2020 which started in January 2017.

Framework for knowledge transfer and sharing

Knowledge transfer is the area of knowledge management that is concerned with the exchange of knowledge across the boundaries of specialised knowledge domains (Carlile & Rebentisch, 2003). Knowledge transfer is the conveyance of knowledge from one place, person, venue or organisation to another. In the traditional sender–receiver model, KT is

successful if the receiving unit accumulates or assimilates subjectively new knowledge. Knowledge transfer involves either communication efforts to disseminate knowledge or active attempts to approach others in order to learn what they know (van den Hooff & de Ridder, 2004).

Knowledge types in agricultural practice

The four types of knowledge that advisors and farmers need to master can be distinguished as follows:

(i) know-what,
(ii) know-why,
(iii) know-how, and
(iv) know-who.

These knowledge forms can be clustered into two complementary main types: codified or explicit knowledge (know-what and know-why) and tacit knowledge (know-how and know-who) (Lundvall & Johnson, 1994; Ingram & Morris, 2007; Klerkx & Proctor, 2013).

Explicit knowledge (know-what and know-why) is standardised knowledge that can be systematised, presented in writing, stored and transferred. It is at the core of the scientific and technical publication systems, as exemplified in patents. Often explicit knowledge is also referred to as information.

- *Know-what* refers to knowledge about facts, including observations, classification, measurement and cataloguing of natural phenomena.
- *Know-why* is knowledge of principles and causal models, often embedded in science and technology.

Tacit knowledge (know-how and know-who) is implicit, local, context dependent and inherently intangible. It results from talent, experience and abilities.

- *Know-how* refers to skills, the capability to do something at practical level as reflected in action, applied to specific cases or settings.
- *Know-who* refers to the social capital of a person, which includes his or her networks, access and norms of reciprocity.

Models to describe knowledge transfer

The process of KT has been widely studied in social sciences. Major & Cordey-Hayes (2000) distinguish node and process models of KT:

(a) *Node models* describe nodes and identify sequences of steps necessary for a KT process
(b) *Process models* describe KT as separate processes that are each undertaken

In node models, actors and networks are presented as nodes with links (ties) between them depicted by connectors (lines). Actors are categorised as committed or influential (ODA, 1995) and ties between actors can be strong or weak. Both strong and weak relationships (i.e. ties) are important for the diffusion of new ideas (Newell *et al.*, 2000). Strong ties are close associations among firms, whilst weak ties link individuals from organisations across different sectors or communities that would not normally make contact during their day-to-day business. These can be equally or more important in the diffusion process because, through weak ties, organisations can encounter ideas that go beyond their usual ways of operating. In process models, the KT is described as separate processes that are each undertaken.

"Linear" KT models are sometimes linked to the slogan "getting research into practice", assuming that there is a provider or source of knowledge (e.g. a scientist) and a receiver (typically a farmer) who acquires subjectively new knowledge. In a linear pathway, from generating research evidence to evidence-informed farming practice, know-how is transferred in a linear and directed way through a series of predetermined steps. This approach is supported by empirical evidence showing that clear, relevant and reliable research findings facilitate the use of evidence-based farming practice.

Integrated KT models rest on the assumption that technical and organisational innovations result from a back-and-forth process between different fields of knowledge, namely:

- scientific knowledge and
- knowledge from practice

Integrated KT models extend the linear models where complexity of domain(s) is high. They are especially relevant where "one-size-fits-all" solutions (e.g. due to high dependency of success on variable local conditions) are not possible, like in the case of grasslands.

Grasslands exhibit a diversity of conditions which require development of locally relevant strategies for getting the best economic, environmental and societal benefits out of grasslands.

Agroecology illustrates a particular relationship between knowledge production and practice, the two processes being no longer distinct and successive but, on the contrary, closely linked and complementary. The production of new knowledge is then akin to "integrated sequences of description, research and action" (Chevassus-au-Louis, 2006). It is then necessary to move from a linear and implicitly top-down and centralised knowledge production model to a more bottom-up approach (Reed *et al.*, 2006) or horizontal approach (Peeters, 2015), or to encourage the consideration of local diversity rather than on orientation towards generalisation and centralised standardisation (Chambers, 1994). Moreover, agroecology offers a new insight regarding dependency of success on local

conditions. The usable knowledge is generated through co-production by researchers and practitioners.

The Agricultural Productivity and Sustainability European Innovation Partnership (EIP-AGRI)

The Innovation Union initiative (European Union, 2013), an action-packed initiative for an innovation-friendly Europe, emphasises that research and innovation are key drivers of competitiveness, jobs, sustainable growth, human health and social progress. The concepts for innovation partnerships in agriculture were established in a Foresight report by the EU's Standing Committee for Agricultural Research (EU SCAR, 2013). The report, merging linear and integrated KT models, highlighted the need for a fundamental reorientation of the KT approach in agriculture, in particular of the organisation of rural extension and training. From a policy perspective, skills and knowledge of land managers in supporting more sustainable land use and food production have become a key focus of both government and industry (Klerkx & Proctor, 2013). Following this line, the EC launched the European Innovation Partnership for Agricultural productivity and Sustainability (EIP-AGRI) in 2012 to contribute to the EU's strategy "Europe 2020" for smart, sustainable and inclusive growth.

With the implementation of the EIP-AGRI, new paradigms were assumed to redesign traditional KT models between science and practice. The EIP initiative aims to address deficits in innovation provision for farmers which result from insufficient information flows between practice and science. To achieve this, the EIP-AGRI aims to:

- provide a working interface between research and farming practice and encourage the wider use of available innovation measures,
- promote faster and wider adaption of innovative solutions in practice, and
- inform the scientific community about the research needs of farming practice.

The EC established EIP-AGRI networks to facilitate communication and exchange on innovation-related information, research results, practice needs and lessons learned. At a national/regional level, Operational Groups, funded by the second pillar schemes of the Common Agricultural Policy (CAP), aim at practical implementation and experimentation.

Since 2014, funding has been provided for projects that facilitate knowledge exchange and collaboration between farmers, researchers, advisors and agri-business to tackle the prevalent needs from the field, supporting the idea that innovation is strengthened by combining knowledge and experiences from a diverse range of people. The concept for multi-actor projects and thematic networks has been laid down in the EU research programme H2020 (COM, 2017). Support for innovation brokers and innovation centres is also envisaged under the EU Research and Innovation Framework Programme and Cohesion and Education Policies.

In its communication paper about the future of food and farmers, the EC has stressed the importance of KT and innovation for the next CAP and suggested that "the strengthening of farm advisory services […] should become a condition for the approval of CAP Strategic Plans" (COM, 2017).

Currently (2018), 17 network projects are funded under this programme. One of them is Inno4Grass thematic network. It is presented here as an example of a proposal to actively encourage innovations in the grassland area.

Concept and approach

The objective of the Inno4Grass project is to develop and implement a methodology for an efficient and effective framework for:

(i) collecting innovations in grassland management and grassland-related productions from commercial farms and from literature, and

(ii) boosting adoption and diffusion of innovations. This is achieved through extending traditional KT approaches and enabling the co-creation of new knowledge and knowledge sharing by a coordinated set of integrated networking activities.

The overall concept of the thematic network project Inno4Grass draws on the identification and promotion of innovative practices and systems for sustainable grasslands. It is based on innovative interactions in a multi-actor approach linking farming practices with science. It is considered that the diversity of conditions likely requires locally relevant strategies for getting the best economic, environmental and societal benefits from grasslands. A mix of stakeholders such as farmers, researchers, advisors and teachers are actively involved in the project.

Inno4Grass uses a combination of traditional skills and new ideas allied to technical know-how and promotion through:

(i) identifying innovative grassland farmers as leading examples and capturing innovative ideas from practice via networks and internet,

(ii) promoting adoption through farmers' groups and early adopters by establishing a multi-stakeholder collaboration and learning network, and

(iii) active dissemination, that is, by stimulating activity of grassland networks with facilitator agents, to persistently bring together and sustainably deploy know-how and innovations.

It is also assumed that essential innovations on grasslands and grassland use may be located at other layers of the whole production chain. Therefore, the analysis of the farming

systems includes milk and meat processing, production, processing and marketing.

The overall conceptual approach makes it possible to better exploit the latest achievements in applied research or even at preliminary stages of testing and at the same time to create more attentive audiences for innovative practices implemented by the most advanced farmers.

Because of the high dependency of grasslands on variable local conditions, many innovations in grasslands originate from farmers' practical experimentation as they exploit the diversity of conditions, so farmers can learn from other farmers. But it is also possible to learn across local experiences, to understand and systematise factors of success and to consolidate good practice through scientific causal understanding and generic knowledge. This dual approach that is adopted in Inno4Grass improves the pace of both novelty creation and adoption across localities, both aspects being in the very core of innovation (OECD, 2005).

Inno4Grass aims to benefit from the diversity within the farmers' population, as identified by Rogers (2003). The project captures innovations from farmers who belong to the "innovators" group and facilitates dissemination to farmers' groups organised around farmers belonging to the "early adopters" group (Figure 1).

The Inno4Grass consortium has identified "innovators" and "early adopters" among grassland farmers across the participating countries. Identification was based on the know-who and networks of consortium partners that have close links to practice communities such as Chambers of Agriculture or extension service organisations. A guideline has been created for describing and suggesting appropriate criteria and methodologies for the selection process.

The consortium considers the early adopters group to be farmers with substantial know-what, know-how, know-who and the ability to adopt innovations in the context of

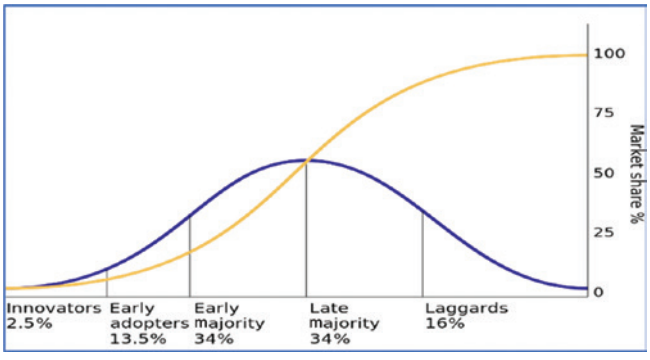

Figure 1. The frequency and cumulated frequency of actors regarding their attitude towards production and adoption of innovations. Adapted from Rogers (2003).

EIP-AGRI. Once adopted or adapted, innovations will be further communicated to the other groups through various means of dissemination and training methods, such as an information management system (IMS) including website, videos, brochures, etc., in close collaboration with the media. As a result, the network contributes to innovations in grassland-based farming systems by closing the gap between farmers and between practice and science. This will be achieved through a wide range of innovative interactions and tools, and by developing additional resources. Three components can be distinguished:

1. Adopting scalable approaches to enable the tapping of innovative capital of outstanding practices and systems from the most innovative farmers;
2. Implementing appropriate methodologies for multi-actor collaboration between practice and science; and
3. Implementing validated methods and tools to synthesise, disseminate and exploit knowledge.

Adopting scalable approaches to enable the tapping of innovative capital

In Inno4Grass, a direct approach of involving innovative farmers is implemented through interviews, consolidated through case studies and further debated through electronic discussion groups. The inclusion of farmers in the design and roll-out of innovations will contribute to closing the gap between practice and science. So far, an inventory of 170 innovative farmers has been created, which is equivalent to 170 innovations or innovative systems. From this group of farmers, potential grassland innovations were gathered through face-to-face interviews, conducted during site visits of about half a day. The information was collected through a standardised questionnaire on structural parameters and open questions on the general functioning and innovations of the farm.

Inno4Grass has developed innovative methods for detecting innovations during face-to-face meetings and surveys. Guidelines and standardised questionnaires for identifying and describing these innovations with meta-information have been established. These potential innovations adapted to different farm types were identified, inventoried and stored in a database. In addition to these interviews, an email questionnaire was sent to members of Farmer's Unions and Livestock Breeder associations in the eight partner countries, asking them *inter alia* to identify innovative practices and farmers.

The internet provides an excellent forum for open discussion since individuals tend to be more open in web-based settings where they are not being physically judged or scrutinised and feel more comfortable sharing (De Vun, 2009). The dispersed knowledge collected from individuals is expected to generate a heterogeneously growing know-how resource. After structuring, this knowledge capital will be shared with

other stakeholders in linguistic groups and groups from other countries, using specifically created electronic discussion groups.

Implementing appropriate methodologies for multi-actor collaboration

Inno4Grass facilitates collaboration between various actors from science and practice (farmers, farmers' organisations, advisors, researchers, etc.). Project partners conduct multi-actor meetings and interactions on farm-level grassland issues that address innovation needs and avenues for tackling these needs. The multi-actor events build on innovations tapped from farmers, knowledge from science (Caron *et al.*, 2014), and experiences and expectations of stakeholders all along the supply chain. This combination is expected to create an improved innovation flow. An inventory and evaluation of existing structures fostering innovation management and brokering, and their practices will enable the creation of a European innovation space for grassland-based farming, extending and connecting existing structures. A common learning environment on grassland-based farming systems will improve the scope for anchoring new grassland developments.

Inno4Grass will develop and test a new method for quantifying the success of a grassland management system with relevant indicators that can be easily collected on farm. The project will develop a facilitation method for stimulating the participation of farmers in workshops where different categories of stakeholders, including scientists, meet. Inno4Grass will also initiate the use of Wikimedia platforms in a farming environment as a tool for the interactive exchange of information, an approach that has proved efficient in many farming communities (Adamides & Stylianou, 2013).

A focus of the Inno4Grass project is to embed farmers' know-how on grassland-based production systems with research and development results in a participatory approach. Grassland knowledge and innovation are useful if readily available to the end user. A combination of integrating current explicit knowledge of both farmers and researchers with new knowledge by active interaction between farmers and researchers is used to create a flow of innovation with respect to grasslands and grassland-based farming and production systems in Europe. Ensuring that best practices in grassland management will be rewarded by grassland peers is a new concept of promoting excellence in practice. Inno4Grass aims to introduce the rewarding of excellence in grassland management. This is important as it sets out a distinct standard for grassland stakeholders to adopt and adjust to. Inno4Grass will challenge the European grassland community to improve, innovate and set a clear agenda for improvements in managing the key resource grasslands and to set a new research agenda for sustainable productive grasslands.

This ambitious approach has been made possible by the composition of the consortium, which includes groups from farmers' organisations, extension services, applied and basic research, and education. In order to strengthen the project, a team of facilitator agents is being established. This concept has already been successfully implemented in the Winetwork (http://www.winetwork.eu/facilitator-agent.aspx). The team of facilitator agents builds on two persons from each of the eight participating countries and will lead the discussion groups and forum, the meetings between farmers and science and most field days. They will be trained to further increase their competencies in technical and scientific knowledge regarding grasslands but also in the skills to run groups gathering a broad range of stakeholders (Guo & Iyer, 2010). This unique human resource will stay active after the end of the project. It will not only be a backbone for this thematic network but also for the grassland community across Europe.

Implementing validated methods and tools to synthesise, disseminate and exploit knowledge

Inno4Grass will combine traditional survey and monitoring methods with electronic communication methods. Inno4Grass aims at facilitating grassland management decision-making by developing a coherent information and communications technology (ICT) infrastructure for knowledge sharing and innovation (Nakasone *et al.*, 2014). That will help farmers to take the best possible decisions, test their ideas and take advantage of the experience of their colleagues in the daily management of their farms. The project will identify the best grassland management software for each country and will support the generalisation of their use on farms. This will improve the precision of grassland management practices and improve the efficiency of home forage resource use.

Participatory approaches will be put at the disposal of participants to contribute to faster and more realistic development and implementation of innovations. The practical and previously tacit knowledge of farmers and advisors will be combined with the more theoretical and explicit knowledge of scientists that has been validated in an established peer-to-peer process. The innovations produced (which will be summarised in practice abstracts) will be made available for large groups of practitioners across variegated local conditions.

Within Inno4Grass, intermediating actors' and farmers' groups (often combined in EIP-Operational Groups) will play a key role in supporting the adoption of novel technologies.

This is important for grassland farmers because (i) the dependency on local conditions for forage production and use of feed in animal production systems is stronger than in most other agricultural sectors, and (ii) multiple channels can be used for disseminating information and knowledge relevant

to grasslands (via practice abstracts, newspapers, social media but also via advisors, seed merchants, technicians for animal production, etc.). Learning from other regions or member states always needs to consider that a "one-size-fits-all" solution does not exist. In Inno4Grass, learning is facilitated by the interaction of case study farms, practical and scientific knowledge and by broad dissemination both through electronic resources and field events. Inno4Grass will initiate a dynamic European exchange platform in Operational Groups (connected to EIP-AGRI) that will persist after the end of the project and will make the European grassland farming community more linked and interactive for the future.

Conclusions

Dedicated innovations for the improvement of grassland performances and their effective implementation in practice are urgently needed to maintain the viability of grassland-based farming across Europe. Interactive innovation models fostering knowledge exchange between practice and science have proven to facilitate such innovations. Usable knowledge is more likely created jointly by researchers and practitioners; an understanding of what works and why is gained through an interactive construction and sharing of knowledge that involves researchers and practitioners to combine generalised and previously tacit knowledge. The creation and diffusion of innovations in agriculture is therefore best understood as a social process that involves iterative knowledge exchange and interaction. Moreover, the diffusion of innovation for grassland in linear models is limited due to the high dependency on local conditions. The theoretical framework of the approach is that the Inno4Grass thematic network will facilitate the identification and testing of innovative ideas from grassroots, facilitate consolidation with scientific knowledge and enrich the research agenda. Inno4Grass provides an example of an approach for creating a space for innovation on grasslands that aims at increasing profitability of European grassland farms and at preserving environmental values through innovative collaboration modes between science and practitioners set by an international network across eight European member states. Methodologies for obtaining extensive collections of farmers' innovative ideas, collaborative works among different stakeholders (farmers' groups, extension services, education and research) and cross-border collaboration where grasslands-related knowledge is made available and adapted to local conditions have been designed. This interactive innovation model that fosters knowledge exchange and implements an IMS is expected to stimulate a new innovation culture for EU grasslands.

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References

Adamides, G. and Stylianou, A. 2013. ICT and mobile phone use for agricultural knowledge sharing by Cypriot farmers. *Agris on-line Papers in Economics and Informatics* **5**: 3.

Adner, R. 2006. Match your innovation strategy to your innovation ecosystem. *Harvard Business Review* **84**: 98–107.

Arthur, W. 1994. "Increasing Returns and Path Dependence in the Economy". University of Michigan Press, Ann Arbor, Michigan.

Carlile, P.R. and Rebentisch, E.S. 2003. Into the black box: the knowledge transformation cycle. *Management Science* **49**: 1180–1195.

Caron, P., Bienabe, E. and Hainzelin, E. 2014. Making transition towards ecological intensification of agriculture a reality: the gaps in and the role of scientific knowledge. *Current Opinion in Environmental Sustainability* **8**: 44–52.

Chambers, R. 1994. The origins and practice of participatory rural appraisal. *World Development* **22**: 953–969.

Chevassus-au-Louis, B. 2006. "Refonder la recherche agronomique: leçons du passé, enjeux du siècle". Leçon inaugurale du groupe ESA, Angers, 27 pages.

De Vun, L. 2009. "Looking at How Crowds Produce and Present Art". Wired News. Retrieved 26 February 2012.

Duru, M., Jouany, C., Theau, J.P., Granger, S. and Cruz, P. 2015. A plant-functional-type approach tailored for stakeholders involved in field studies to predict forage services and plant biodiversity provided by grasslands. *Grass and Forage Science* **70**: 2–18.

European Commission. 2010. "Europe 2020 Flagship Initiative Innovation Union. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions". COM (2010) 546 Final, Brussels, Belgium, 43 pages.

European Commission COM. 2017. "713 Final: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – The Future of Food and Farming". European Commission COM, Brussels, Belgium, 26 pages.

EU SCAR. 2013. "Agricultural Knowledge and Innovation Systems Towards 2020 – An Orientation Paper on Linking Innovation and Research". EU SCAR, Brussels, Belgium, 210 pages.

Eurostat. 2010. In: Osoro, K. 2014. "EIP-AGRI Focus Group Profitability of Permanent Grassland". Starting paper. https://ec.europa.eu/

eip/agriculture/sites/default/files/fg9_permanent_grassland_profitability_starting_paper_2014_en.pdf.

European Union. 2013. "Innovation Union. A Pocket Guide on a Europe 2020 Initiative". Publications Office of the European Union, Luxembourg, 20 pages.

Green, R.E., Cornell, S.J., Scharlemann, J.P.W. and Balmford, A. 2005. Farming and the fate of wild nature. *Science* **307**: 550–555.

Guo, L. and Iyer, G. 2010. Information acquisition and sharing in a vertical relationship. *Marketing Science* **29**: 483–506.

Horibe, F. 2007. Are you making familiar mistakes with innovation? *Knowledge Management Review* **9**: 8–10.

Huyghe, C., De Vliegher, A., van Gils, B. and Peeters, A. 2014. "Grasslands and Herbivore Production in Europe and Effects of Common Policies". Quae Editor, Versailles, 320 pages.

Ingram, J. and Morris, C. 2007. The knowledge challenge within the transition towards sustainable soil management: an analysis of agricultural advisors in England. *Land Use Policy* **24**: 100–117.

Klerkx, L. and Leeuwis, C. 2009. Establishment and embedding of innovation brokers at different innovation system levels: insights from the Dutch agricultural sector. *Technological Forecasting and Social Change* **76**: 849–860.

Klerkx, L. and Proctor, A. 2013. Beyond fragmentation and disconnect: Networks for knowledge exchange in the English land management advisory system. *Land Use Policy* **30**: 13–24.

Klerkx, L., Noelle, A. and Leeuwis, C. 2010. Adaptive management in agricultural innovation systems: the interactions between innovation networks and their environment. *Agricultural Systems* **103**: 390–400.

Lundvall, B.A. and Johnson, B. 2004. The learning economy. *Journal of Industry Studies* **1**: 23–42.

Major, E.J. and Cordey-Hayes, M. 2000. Engaging the business support network to give SMEs the benefit of foresight. *Technovation* **20**: 589–602.

Mulgan, G. 2006. The process of social innovation. *Innovations: Technology, Governance, Globalization* **1**: 145–162.

Nakasone, E., Torero, M. and Minten, B. 2014. The power of information: the ICT revolution in agricultural development. *Annual Review of Resource Economics* **6**: 533–550.

Nelson, R.R., ed. 1993. "National Innovation Systems: A Comparative Analysis". Oxford University Press on Demand, Oxford.

Newell, S. and Swan, J. 2000. Trust and inter-organizational networking. *Human Relations* **53**: 1287–1328.

OECD. 2005. "Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data". 3rd Edition. OECD, Eurostat Publication, Paris, 164 pages.

OECD. 2017. Land Use and Ecosystem Services in Agriculture. COM/TAD/ENV/EPOC (2016) 24 Final. https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=COM/TAD/CA/ENV/EPOC(2016)24/FINAL&docLanguage=En.

Olsson, A., Campana, P.E., Lind, M. and Yan, J. 2014. Potential for carbon sequestration and mitigation of climate change by irrigation of grasslands. *Applied Energy* **136**: 1145–1154.

Overseas Development Administration, ODA. 1995. "Guidance Note on How to Do Stakeholder Analysis of Aid Projects and Programmes". Overseas Development Administration, London, 10 pages.

Peeters, A. 2015. Participatory and holistic approaches with grassland farmers and development of policies. In: "Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection" (eds. D. Vijay, M.K. Srivastava, C.K. Guupta, D.R. Malaviya, M.M. Roy, S.K. Mahanta, J.B. Singh, A. Maity and P.K. Ghosh), Army Printing Press, Lucknow, India, pages 290–305.

Planck, U. and Ziche, J. 1979. "Rural and agricultural sociology. A textbook on sociology of rural settlement area and agriculture". Ulmer, Stuttgart, Germany.

Reed, M.S., Fraser, E.D. and Dougill, A.J. 2006. An adaptive learning process for developing and applying sustainability indicators with local communities. *Ecological Economics* **59**: 406–418.

Rogers, E.M. 2003. "Diffusion of Innovations". 5th Edition. Simon and Schuster, New York, USA, 576 pages.

Ryals, R., Hartman, M.D., Parton, W.J., DeLonge, M.S. and Silver, W.L. 2015. Long-term climate change mitigation potential with organic matter management on grasslands. *Ecological Applications* **25**: 531–545.

Silva, J.P. 2008. "Life and Europe's Grasslands – Restoring a Forgotten Habitat". European Commission DG Environment, Luxembourg.

Van den Hooff, B. and De Ridder, J.A. 2004. Knowledge sharing in context: the influence of organizational commitment, communication climate and CMC use on knowledge sharing. *Journal of Knowledge Management* **8**: 117–130.