

Linking Innovation and Research in Agricultural Knowledge and Innovation Systems

Krijn Poppe

LEI Wageningen UR, The Netherlands, krijn.poppe@wur.nl

Abstract: Innovation is high on the agenda, in view of the deep economic crisis and the challenges of feeding 9 billion people in 2050 in a more sustainable way. For an effective and efficient response the Agricultural Knowledge and Innovation Systems (AKIS) needs to innovate itself and adopt new ways of working. This paper reports on work carried out by the EU's SCAR to implement the European Union's (EU) European Innovation Partnership (EIP) 'Agricultural Productivity and Sustainability' in relation to Horizon2020.

National and regional governments can stimulate innovation by implementing the EIP through multi-actor operational groups that work in a participatory way. This is to be translated in an instrument portfolio that consists of incentives for research, development and innovation as well as the stimulation of knowledge exchange, adoption of innovation and technical application in the production process. The support of facilitators and innovation brokers is of core relevance for AKIS as well as the establishment of operational groups.

Special attention is needed to incentivize research to be responsive to the needs of innovation processes. Our recommendations suggest that at least for some of the Horizon2020 project calls or national funded research better incentives could be installed to link innovation and research.

Multi-actor innovation might benefit from modern ICT support. There is a great potential for using existing social software tools and platforms for communication, interaction, knowledge sharing, preservation of information and as such stimulate multi-actor innovation.

The difference between innovation and research means that governments have more instruments than research to promote innovation. Extension and education, fiscal measures, credit guarantees, innovative procurement, inducements like prizes and other incentives can help too. There is an important European dimension to innovation and innovation policy.

Keywords: Innovation, Research, Agricultural Knowledge and Innovation Systems, Innovation Policy

Introduction

The current economic crisis has put innovation high on the policy agenda. Also recent worries about scarcities and the functioning of the food system, including negative (environmental) aspects of the production systems have led to calls for more innovation.

This paper reports on work carried out by the EU's SCAR to implement the European Union's European Innovation Partnership (EIP) 'Agricultural Productivity and Sustainability' in relation to Horizon2020. The SCAR is the Standing Committee of Agricultural Research and coordinates agricultural research and innovation in the European Research Area.

The objective of the paper is to investigate how the need for innovation could be best be addressed through government policies, given the state of the current AKIS and what this means for the future of the AKIS.

The needs for innovation have emphasized discussions on the organisation of the Agricultural Knowledge and Innovation Systems (AKIS). Innovation and research are different concepts. More research does not automatically mean more innovation. The AKIS have been criticized for being unable to absorb and internalise the fundamental structural and systemic shifts that have occurred. The publicly funded AKIS appear to be locked into old paradigms based on linear approaches and conventional assumptions (Brunori et al., 2008).

Innovation defined

Innovation is a broad concept. The OECD defines it 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 organisation or external relations. This implies that innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Innovation is often linked to businesses, but it should not be forgotten that the public domain, which is the other 50% of the European economy, can innovate to. This includes the public aspects of agriculture ('multifunctionality').

In addition the term social innovation has become popular (Bock, 2012). This concept has roughly three different meanings. It originates in critiques of traditional innovation theory and points at the need to take the social mechanisms of innovation into account: people have to adapt their working routines to adopt a new method or (making a) new product.

In the context of rural development, social innovation refers to the (social) objectives of innovation – that is those changes in the social fabric of rural societies, that are perceived as necessary and desirable in order to strengthening rural societies. In this meaning of social innovation the social inclusion or equity aspect is stressed. A third meaning refers to the social responsibility of innovations: new technologies might have negative aspects for some stakeholder groups that should be addressed.

Innovation policy

Smits et al. (2010) distinguishes two views on innovation policy: the systems of innovation approach versus the macro-economic approach. The macro-economic view tends to see innovation as a linear process from (basic) research via R&D to a commercial application. The main rationale for the government to act is market failure and the main policy instrument is science or research policy. As there is also a risk of government failure, the choices on the direction of innovation should – in this view – be left to the market as much as possible: the market organises the allocation of resources. It leads to a fairly clear policy that can be monitored by trends in science-based indicators.

The systems of innovation view has a more complicated approach to innovation and innovation policy. The focus is on interaction between different stakeholders in the innovation process. The main rationale is that there are systemic (network) problems in the system or the creation of new innovation systems. Therefore an innovation policy is needed. However that innovation policy makes choices and is much more context specific. In the Systems of Innovation view, a well-developed knowledge and innovation system has seven functions (Bergek et al., 2010):

- 1) Knowledge development and diffusion;
- 2) Influence on direction of search and identification of opportunities;
- 3) Entrepreneurial experimentation and management of risk and uncertainty;
- 4) Market formation;

- 5) Resource mobilisation;
- 6) Legitimation;
- 7) Development of positive externalities.

Innovation systems can be analysed according to these functions, and blocking mechanisms to develop or improve these functions can be identified; this can be a basis for policy intervention.

The critique on AKIS that they are locked into old paradigms based on linear approaches and conventional assumptions (Brunori et al., 2008) can be interpreted as a comment that they are too much linked to the first type of innovation policy and should move to the second type. However this should be taken with a grain of salt, as the AKIS (as we will see in section 3 of this paper) are themselves very much based on the systems-of-innovation view. The critique was also linked to the fact that AKIS are traditionally more focusing on productivity than on the policy objectives of sustainability and multi-functionality.

Organisation of the work for this paper

The investigation reported in this paper is based on earlier work (EU SCAR, 2012) concerning AKIS (reported in more detail in section 3). This work defined and described AKIS in general terms, linked it to the concept of innovation and innovation policy (as reported above) and gathered experiences from the member states of the European Research Area.

In this new work we continued with the SCAR collaborative working group AKIS as a community of practice that discussed the policy ideas and proposals concerning EIP (reported in more detail in section 2) as well as relevant examples from the member states that could be interpreted as good examples *avant-la-lettre* that fit into the new EIP (reported in section 4). Discussions in the community of practice on these examples helped the civil servants to shape the details of the EIP legislation.

The working group gathered 5 times for 2-day meetings in a period of one year, and two one-day meetings as kick-off and closing session (to review the draft end report). Based on a common format of a powerpoint, provided by the leadership of the group, the participants from member states reported information from their country as a basis for discussion. In addition experts were asked for presentations and creative techniques like brainstormings, De Bono's thinking hats etc. were used.

Special attention, with a desk research study (Jespersen et al, 2013) was paid to the role of ICT, as this technology (and especially social media) is reshaping forms of collaboration. This is reported in section 5.

More attention to innovation in the AKIS implies new ways of working and incentivizing researchers and research institutes to do so. This was the topic of a second desk research (Home et al, 2013), that is reported here in section 6. Based on this we formulate recommendations for national and regional policy makers, including suggestions for monitoring.

Policy context

Policy makers have reacted to the demand for more innovation by taking measures to also speed up innovation in agriculture and the wider bio-based economy. The European Innovation Partnership (EIP) for 'Agricultural Productivity and Sustainability' aims to foster a competitive and sustainable agriculture and forestry that 'achieves more from less' input and works in harmony with the environment. For achieving this aim, the EIP will build bridges between research and farming practice. The EIP adheres to the "interactive innovation model" which focuses on forming demand-driven partnerships - using bottom-up approaches and linking farmers, advisors, research-

ers, businesses, and other actors (e.g. civil society like ngo's or governmental bodies) in so-called *Operational Groups*.

The EIP network will facilitate the effective flow of information. A Brussels based EIP network facility, called the "EIP Service Point", is installed to support this. An important action format of the EIP Network is the so-called Focus Group that bring together up to 20 experts willing to engage in sharing knowledge and advancing practical innovative solutions to address key challenges.

For funding concrete innovative actions, the EIP-AGRI will be implemented through actions that are mainly supported by two Union policies: Rural Development Policy and Horizon 2020. In the Rural Development Policy several measures can be used to stimulate innovation and the activities of operational groups. The key measures include 'cooperation', 'knowledge transfer and information actions', 'advisory services', 'investment in physical assets' and 'farm and business development'.

Within the framework of Horizon 2020, two new instruments were developed that are instrumental for the EIP: multi-actor projects and thematic networks. The key feature of multi-actor projects is to "ensure the necessary cross-fertilising interactions between researcher, businesses, farmers/producers, advisors and end-users" in order to address the needs, problems and opportunities of end-users.

Agricultural Knowledge and Innovation Systems

AKIS is a useful concept to describe a system of innovation, with emphasis on the organisations involved, the links and interactions between them, the institutional infrastructure with its incentives and the budget mechanisms. Although the components *Extension (Farm Advisory) system*, *Education* and *Research* are often stressed, it is important to realise that there are many more actors in the food chain that directly influence the decision making of farmers and their innovations.

Different parts of AKIS, such as education, extension and research face different challenges. They are also governed with different incentives, which can be problematic for synergy and cooperation within an AKIS. Education is often weakly connected to the other components. Applied research is often reviewed on scientific output, much less on relevance.

AKIS are very different between countries, regions and sectors. Although they are changing (some countries have restructured their AKIS considerably) and diversity is useful in innovation and transitions, there is no guarantee that they are fit to answer the challenges posed by the need to increase productivity and sustainability in agriculture and food production (EU SCAR, 2012).

Networking and cooperation between research and extension or farmers' groups is to be promoted. Agenda setting by farmers and food business is more important than more research dissemination. The EU SCAR AKIS therefore advocated a distinction between science-driven research and innovation-driven research. Programming, farmer/business involvement and the role of the EU are quite different in both types.

AKIS are governed by public policy but consistent AKIS policies do not exist. Monitoring of AKIS (input, system, output) is fragmented. The high level of attention to 'innovation' in the policy domain and the lack of research for evidence-based policy are inconsistent. (EU SCAR, 2012).

Examples of interactive innovation

Although the term "operational group" is new in the Rural Development policy, some initiatives in European countries already applied an interactive innovation approach. Some examples discussed in the Community of Practice of the SCAR-AKIS working group include:

Innovation and Partnership Projects (France) An annual call for projects "Innovation and Partnership" is set up by the French Ministry of Agriculture as of 2004 under CASDAR funding. The objective of the projects is to produce operational results in a user-friendly way to farmers and to have an adequate partnership for the project work. One IP project can be funded between 250k€ or 450 k€ for 3 years and the projects are conducted in partnership between development and advisory services, research and training agencies, including groups of farmers. Farmers are involved in the project's steering committee and assist in making up the experimental plan and in orienting the project. Projects conducted in this framework have a practical aim: to produce results conducive to innovation, easily transferable to advisors and farmers, and that can contribute to the definition of public policies. Topics to be chosen may be linked to societal challenges (described in a tender) or subjects supported by Joint Technology Networks.

KarjaKompassi (Cow Compass, Finland) At the basis of the Cow Compass was the objective to develop an on-line management tool to support process planning, ration formulation and optimal economic operation of cattle farms. It's now an on-line service for farmers delivered by a rural advisory service. The development stages were highly interactive between research, extension and farmers (for testing and piloting).

Improve quality of Danish beans by heat treatment (Denmark) The aim of the project was to improve the quality of Danish beans through heat treatment. This included the testing of a mobile toaster unit at a farm and the testing and monitoring of proteins in cows. The initial question was formulated by a farmer and in the end, the project was carried out by a team of farmers and knowledge institutes.

Better farm Programme (Ireland) The programme wants to improve the farms' profitability through technology transfer and feedback to research. This happens with involvement of the farmers and demonstration farms. The approach has been influenced by a participatory approach.

Riduca reflui (Italy) The aim of this project is to search for technological and managerial solutions for the reduction of water pollution due to the use of animal waste. The initial demand came from the farmers' organization, but was promoted by the Veneto region and carried out together with research and extension.

Water quality groups (Flanders) In the framework of the Nitrate directive, it was necessary to address the issue of water quality in Flanders. As one of the measures, local networks of farmers and applied researchers were established to follow-up, explain and address the results of the nitrate measurements in specific water bodies.

HortLINK Project SCEPTRE – A LINK Consortium (UK) Defra's HortLINK is a collaborative programme with industry and end-users to translate R&D into a commercial reality. In the specific case of SCEPTRE, the focus is upon improving crop protection in horticulture and especially for the use in minor crops. In these minor crops, there are fewer effective products available as a result of EU legislation and the failure of the market to develop new products.

Good Fruit (Estonia – Latvia) Within the Good Fruit project, a complex unit has been developed to store and process fruit and berries to provide product development service throughout the year. Researchers initiated the project and they were joined by about a hundred small farmers. They are using the processing department and the storage and product development services of the research institute.

The key success factors in these projects strongly depend upon the specific context, challenge and constitution of the group. The composition of and way of working within the group turns out to be an important key success factor. Self-organisation seems to be a pre-requisite, trust essential. The initiatives under study suggest a consortium with a range of stakeholders involved in the activities and this on a voluntary base. It can help if the group builds upon existing relations between people who are open to discuss their problems. Between the stakeholders, there should furthermore be a close and active cooperation and all actors should commonly define and co-construct the "raison d'être", goals and objectives of the group. Other supporting elements are (i) the presence of neutral actors or facilitators within the group that facilitate and drive the process forward, motivate others and resolve conflicts, (ii) a specific critical mass of the group according to its project objectives and (iii) complementarity of expertise and experience.

New operational groups can use such existing experiences in the AKIS where innovative farmers develop successful new practices, products and services or machinery and even software. One of the roles of AKIS in knowledge development and diffusion always has been to work with those innovators in order to understand their innovation scientifically, standardize it and roll it out to other farmers. Another is to help farmers to solve questions and challenges that farmers encounter in an innovation process. This might call for innovation brokering, depending on the accessibility of the AKIS. Farm advisors with a good understanding of innovation and the AKIS might fulfil this role.

Role of ICT

This section deals with the issue if and how ICT (including social media) could support innovation processes in the AKIS and the EIP. Innovation should be based on software, hardware and 'orgware'. Based on a conceptual framework of socio-technical networks, innovation and learning processes in relation to ICT, various types of software tools have been evaluated.

Already today there is a multitude of ICT and social media tools, which can be used in the agricultural sector for knowledge sharing and innovation. Further, what they offer and how they differ from each other are described in the full report (Jespersen et al. 2013).

Concerning the use of ICT tools in innovation processes, it is not possible to predict which ICT tools (Table 1) will be best to use in a given situation, but focus should be on the end user and the purpose of the network. Regular updates in the content of the ICT tool, selecting first movers, ambassadors etc. may play an important role in a successful application.

Table 1: Software types, evaluated tools (in bold text) and other examples of tools of the different types and successful examples of application of the tools, mainly in agriculture.

Software type	Tools evaluated	Successful examples
Knowledge portals (KP)	<i>Search engines:</i> Google, Yahoo <i>Slide and document sharing:</i> Slideshare <i>Video and photo sharing:</i> YouTube , Flickr	VOA3R, eXtension, Chil
E-document management systems (E-MS)	<i>Digital libraries:</i> Groen Kennisnet in NL, Organic Eprints	Organic Eprints, Agriwebinar
Data Warehouse (DW)	Eurostat, FADN	FADN
Groupware (GW)	Wikipedia, Yammer, Crowdsourcing	British Farming Forum, Lego Cuusoo, Climate CoLab, P&G Connect+Develop, Betacup Challenge
Community of practice (CoP)	ResearchGate, Erfaland	Disease surveillance and warning systems, IDRAMAP
Social communities of interest (SCI)	Facebook, LinkedIn, Google+, Ning, Quora	AgTalk+, E-Agriculture, Jeunes-agriculteurs, E-agriculture, Rede Inovar
Individual communities of interest (ICI)	Wordpress, Twitter, Blogs	AG Chat

Multi-actor innovation might benefit from modern ICT support. There is a great potential for using existing social software tools and platforms for communication, interaction, knowledge sharing, preservation of information and as such stimulate multi-actor innovation.

Incentivizing research

Special attention is needed to incentivize research to be responsive to the needs of innovation processes. Figure 1 presents ten recommendations from a desk research carried out by FIBL (Home et al, 2013). These include six potential changes at the level of research policy, e.g. the creation of evaluation criteria for both research proposals and research institutes to stimulate transdisciplinary and interactive research, the involvement of practitioners in research funding and evaluation processes, the support for sabbaticals and short-term visits to stimulate exchange of practices between stakeholders, the creation of funding for projects that involve science and practice on an equal footing and the establishment of an easily accessible data base for high quality non-academic publications/articles. The other four recommendations are formulated with regard to research institutions. They concern the development of targeted training courses to enhance the necessary skills for effective science-practice interaction, the creation of specialised centres and of a new discipline Integration and Implementation Sciences, the establishment of a data base with information about institutions, methods, tools, publications and trainings on interactive research and, finally, including the assessment of a researcher's (non-academic) societal impact into the overall evaluation of his/her performance. It will depend on the national or regional AKIS how relevant the recommendations are. But it is clear that at least for some of the Horizon2020 project calls and national funded research better incentives can be installed to link innovation and research.

Figure 1: Ten recommendations on incentives and enablers to make research more responsive to innovation processes.

	Policy	Institution
Incentives <i>„pull“</i>	P1: New evaluation criteria for funding of research proposals	I10: Include societal impact into the overall evaluation of a researcher's performance
	P2: Include practitioners/experts on selection committees for project funding	I7: Training courses for academics at all levels
	P3: New evaluation criteria for performance of institutions	
	P5: Funding for research-practice partnerships	I8: Creation of centres for Integration and Implementation Sciences
Enablers <i>„push“</i>	P4: Sabbaticals for short-term visits of researchers outside academics	
	P6: Data base for high quality non-academic publications	

Recommendations for national and regional Innovation policies

The difference between innovation and research means that governments have more instruments than research to promote innovation. Extension and education, fiscal measures, credit guarantees, innovative procurement, inducements such as prizes and other incentives can help too. This implies that in addition to a science and research policy it makes sense to have an innovation policy. There is an important European dimension to innovation and innovation policy. Where cross-border collaboration in research clearly exists and increases, cross-border collaboration in innovation should be improved. This seems to be even more an issue as the research networks are biased to the oldest member states / north-western Europe, and widening participation is a policy objective.

The SCAR AKIS working group concluded that national and regional governments can stimulate innovation by implementing the EIP through multi-actor operational groups that work in a participatory way. This should be translated in an instrument portfolio that:

- Gives incentives for research, development and innovation;
- Stimulates knowledge exchange, adoption of innovation, technical application in the production process;
- Supports the activities of facilitators, innovation brokers and tutoring paths for farmers to implement innovations;
- Compensates the time devoted by farmers;
- Supports operational groups to develop cross-border interactions;
- Invests in AKIS-subsystems that have been underdeveloped in the specific national or regional situation.

Governments should set a framework that provides continuity in the actions and activities of operational groups, introduces new methods to legally safeguard SME's knowledge and facilitate partnership agreements, makes it easy to participate (low bureaucracy), gives operational groups an advantage in the application for support schemes, acknowledges the practical field experience of farmers and improves the accessibility of knowledge and the free availability of information. Innovations in innovation policy are possible, such as the use of SBIR (Small Business Innovation Research programs), vouchers and prizes as inducements.

Cross-border collaboration in research could benefit from harmonisation of rules and procedures for commissioning research, to help to create to a more integrated 'market' for research. That does not mean that national or regional authorities should give up their strategy and agenda setting processes, but they could adopt such procedures that research institutes could easier match national and international funds.

Monitoring for evidence-based policy making

Innovation policies should be monitored and evaluated. Monitoring of the AKIS as well as innovation itself is at best fragmented (EU SCAR, 2012). Available data report mainly on R&D in the food industry, on patents and on publications of the research system. There are no systematic monitoring reports for parliaments and the public, but sometimes an ex-post policy analysis of certain innovation programs is carried out. This led the SCAR working group to the conclusion that the high level of attention to "innovation" in the policy domain and the lack of research for evidence-based policy are inconsistent.

Innovation can be measured, the so-called Oslo manual of the OECD (formally "The Measurement of Scientific and Technological Activities, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data") contains guidelines for collecting and using data on innovation. Eurostat's Community Innovation Survey has a business size threshold of 10 employees and therefor excludes most farms. A few member states monitor innovation in their Farm Accountancy Data Network (van Galen and Poppe, 2013), which gives the possibility to investigate relations with farm type, farm size, financial resources and effects on value added and sustainability.

Data on Agricultural Knowledge and Innovation Systems, and the relationship between the different indicators are scarce. EU Projects like Solinsa and Pro-AKIS contribute to the documentation of the national and regional AKIS.

Discussion and conclusions

The objective of the paper was to investigate how the need for innovation could be best be addressed through government policy, given the state of the current AKIS and what this means for the future of the AKIS.

We have shown how an interactive process in a community of practice between civil servants linked to scientific experts has led to concrete policy proposals that are now (to be) implemented in the Common Agricultural Policy's Rural Development plans and in Horizon2020. The participants in the working group found the working methods and results very satisfactory and the SCAR itself has asked the group to continue its work with an extended mandate. Unfortunately the participation from Eastern European countries was limited.

Innovation is high on the policy agenda. The literature and the work in the collaborative working group SCAR-AKIS show that innovation policy and research (or science) policy are different

thing, although related. Scientists are challenged to contribute more to innovation than they currently do. This implies that for an effective and efficient response the Agricultural Knowledge and Innovation Systems (AKIS) need to innovate themselves and adopt new ways of working. Modern ICT systems could support multi-actor approaches in working as well as cross-border innovation processes. Incentives have to be changed to link research better to this new type of working.

References

- Bergek, A. et al. (2010) Functionality of Innovation Systems as a Rationale for and Guide to Innovation Policy. In: Smits et al. (2010)
- Bock, B. (2013) Social Innovation. In: EU SCAR (2013)
- Brunori, G. et al. (2008) New Challenges for Agricultural Research: climate change, food security, rural development, agricultural knowledge systems – 2nd SCAR Foresight report. Brussels, European Commission.
- EU SCAR (2012) Agricultural Knowledge and Innovation Systems in Transition – a reflection paper. Brussels, European Commission
- EU SCAR (2013) Agricultural Knowledge and Innovation Systems towards 2020 – an orientation paper on linking innovation and research. Brussels, European Commission
- Jespersen, L.M. et al. (2013) ICT and Social Media as Drivers of Multi-actor Innovation in Agriculture – barriers, recommendations and potentials. In: EU SCAR (2013)
- Home, R. and H. Moschitz (2013) Incentive Mechanisms for Researchers to Participate in Targeted Interactive Research and Innovation Processes – beyond academic relevance. In: EU SCAR (2013)
- Smits, R. et al. (2010) The Theory and Practice of Innovation Policy – an international research handbook. Edgar Elgar.