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FACILITATING INNOVATION IN AGRICULTURE: LESSONS FROM A EUROPEAN PERSPECTIVE

ABSTRACT

The necessity of achieving ‘sustainable intensification’ of agricultural production is now widely accepted and the topic of this paper is how innovation in agriculture can be better facilitated in order to achieve this. The paper brings together several interrelated strands of thinking on approaches to stimulating innovation and entrepreneurship in rural areas, in particular amongst the farming community. Recent developments in the concept of agricultural knowledge and innovation systems (AKIS) are described and the need to better understand knowledge flows within the AKIS is stressed. The paper proposes the driving force, pressure, state, impact and response (DPSIR) model as a possible framework for policy intervention in promoting entrepreneurship and innovation, and discusses the importance of improving the ‘enabling environment’ for innovators. The ADER project from the UK is presented as a case study of good practice, while the paper concludes that there is an urgent need to develop further models for encouraging agricultural innovation in other farming situations, such as those in eastern central Europe.

Key words: sustainable intensification, agricultural knowledge and innovation systems, knowledge flows, the DPSIR model, enabling environments.

JEL Classification: Q14.

1. INTRODUCTION

Innovation is often described as a new idea that proves successful in practice. OECD (2005) defines an 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 organisation or external relations’ (p. 46). The topic of this paper is how to better facilitate innovation in agriculture.

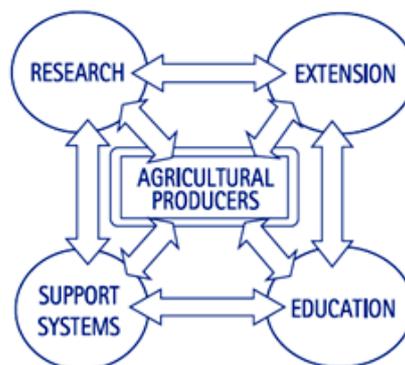
Anticipated resource constraints (such as water) and increasing importance attached to the value of ‘public goods’, coupled with rapid climate change and the need to globally feed 9 billion people in 2050, means that the necessity of achieving ‘sustainable intensification’ of agricultural production is now widely accepted (Godfray *et al.*, 2010). More food should be produced but at the same time agricultural production should become more sustainable regarding people, planet and profit. This calls for more innovation in agriculture, and the topic is now attracting much attention amongst policy makers. The OECD has recently published a study on agricultural innovation systems (OECD, 2013), while the

European Union (EU) is in the process of setting up its European Innovation Partnership ‘Agricultural Productivity and Sustainability’. The United Nations Industrial Development Organisation (UNIDO), through its head office in Wien and in cooperation with BOKU (university in Wien), is conducting research into ‘insights to rural enterprise development’ which primarily addresses farming and takes into account general as well as sectoral policies (Hartwich *et al.*, in preparation).

This paper brings together several interrelated strands of thinking, partly drawn from the above and also from the author’s own experience, on approaches to stimulating innovation and entrepreneurship in rural areas, in particular amongst the farming community. It also proposes the driving force, pressure, state, impact and response (DPSIR) model as a possible framework for policy intervention in promoting entrepreneurship and innovation. The ADER project from the UK is presented as a case study of good practice that takes into account many of these considerations, and in the final section some general conclusions are drawn.

2. AGRICULTURAL KNOWLEDGE AND INNOVATION SYSTEMS

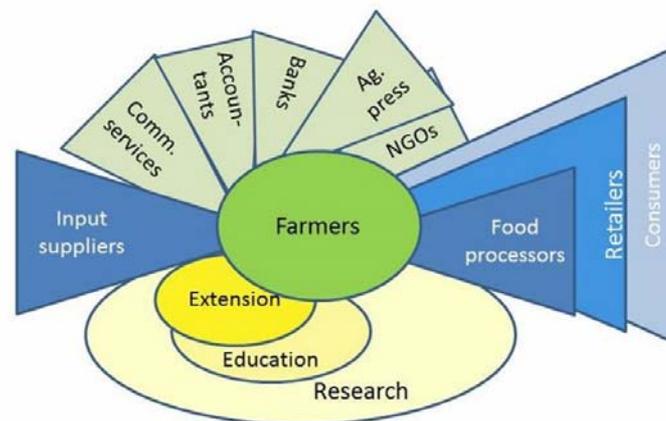
Several years ago, prompted by organisations such as OECD and FAO, the concept of ‘agricultural knowledge and innovation systems’ (AKIS) was introduced into the policy discourse. The concept was based on the idea that, in order to accelerate agricultural modernisation, innovation transfer should be strongly coordinated (Leeuwis and van den Ban 2004). It was implemented in many countries through a close integration, generally at national level, of public research, education and extension bodies, in many cases under the control of the Ministry of Agriculture. AKIS was seen as embracing four main groups of actors (Figure 1) whose mission is related to agricultural innovation, namely *research*, *extension services*, *education and training*, and *support systems* (i.e. producers’ associations, credit and input organisations etc.).



Source: Rivera *et al.* (2005).

Figure 1. A model of an Agricultural Knowledge and Innovation System.

The model advanced by Rivera *et al.* 2005 is simple if not simplistic and SCAR (2013) notes that “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” (p. 16). A new model of the AKIS (Figure 2) is proposed by SCAR (2013) that positions the farmer within the *supply chain*, itself a major improvement, firstly as this is an important channel of information, knowledge and advice, and secondly as the model recognises the need for markets for innovations. The *Extension system*, *Education* and *Research* components are retained, and a new set of actors in the innovation process are introduced. Of these, *commercial services* include laboratories, veterinarians, management software, notaries, land brokers etc. SCAR (2013) states that *accountants* have been mentioned separately as being in some countries very influential on strategic decisions often stressed.



Source: SCAR (2013).

Figure 2. Actors in the AKIS directly relevant to agricultural innovation in the food chain.

The inclusion of these ‘new’ actors in the AKIS model is consistent with the findings of Fieldsend *et al.* (2005), who identified *accountants* as a very important source of support to rural businesses in general in both the UK and Hungary. *Banks*, *solicitors* and *financial advisors* were also included in their list. A source that was identified by Fieldsend *et al.* (2005) as being very highly valued by rural business people and that should certainly be added to Figure 2 is *friends and family*. Other sources included *local government*, *trade organisations*, *business development agencies* and the *voluntary sector*. Riviera *et al.* (2005) would presumably classify these under *support systems*. Maybe Figure 2 includes these actors if *NGOs* is seen as a ‘catch-all’ category.

A weakness of Figure 2, compared to Figure 1, is that it does not explicitly show information, knowledge and advice flows. Knowledge flow systems are an essential component of AKIS. A knowledge flow system can strictly be seen as the

flows of knowledge through an AKIS, including producers of knowledge (the supply side), information channels, and users of knowledge (the demand side). A traditional view of a knowledge flow system would include research as a source of knowledge, extension and education as knowledge and information channels, and agricultural entrepreneurs as recipients of knowledge. This 'linear' view is especially applicable to the situation in which researchers produce knowledge in terms of new technologies, such as farm machinery. Extension and education can spread this knowledge to the farmers, for instance by demonstration or written communication, and the farmers can apply it by using the new technology or machinery.

The AKIS model needs to better characterise knowledge flows, which are often multi-directional or 'participatory' rather than linear (SCAR, 2013). Figure 2 includes *agricultural press* as a component of the AKIS, but is it in fact part of the knowledge flow system through the AKIS? Fieldsend *et al.* (2005) noted *Internet* as an important source of support to rural entrepreneurs, not just in the UK, and this, too is a channel through which knowledge flows. This is a rapidly developing area of research with, for example, King (2011) noting that electronic communication is an increasingly important medium for UK farmers.

Knowledge flows should be designed to maximise farmer (actor) participation in the AKIS. In many parts of Europe there has been a historical tendency when developing farm extension programmes to design a 'one size fits all' approach which assumes that all land managers are similar in their life and business goals, similar in their learning styles and are all profit motivated. Most of these programmes have also had a 'top down' approach where information is provided to land managers which is intended to persuade them to change their behaviour. Such an approach to knowledge transfer must now be considered as outdated, for at least two reasons.

- *The political context of food and farming systems has changed.* Agricultural practices are now set within the context of achieving sustainability and responding directly to consumer concerns. Agricultural research also has to address a range of related issues and demands, from the need for stable food security and safety systems, environmental criteria, socio-economic changes in rural communities, to issues such as landscape management, biodiversity and conservation.

- *Farming is much more diverse than in the past and is often combined with other activities.* New knowledge is generated by farmers as well as researchers (basic and applied) and private companies and the importance of informal knowledge networks is increasingly recognised (Knickel *et al.* 2009). EC (2009) described AKIS in Europe as "currently unable to absorb and internalise the fundamental structural and systemic shifts that have occurred" (p. 95). It concluded that the old linear model of knowledge transfer (from scientists to the users) is outdated and should be replaced by an interactive model of networking systems, which integrates knowledge production, adaptation, advice and education.

However, setting up of such a ‘top-down’ structure in itself is not a guarantee of farmer participation. Research work reported by Murphy (2012) has identified at least five sets of non-financial variables that influence the decisions of farmers on the adoption of new technologies and policies:

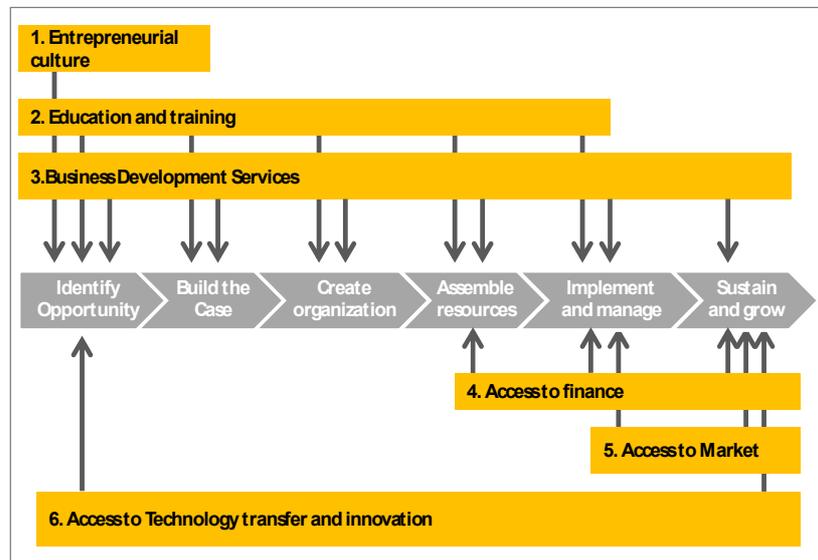
- *Farmer characteristics* (age, education, gender, attitude to risk and personality);
- *Household characteristics* (stage in family cycle, level of pluriactivity and work patterns of spouse);
- *Farm structure* (farm type, farm size and debt to asset ratio);
- *The wider social milieu* (level of extension available, information flows, local culture, social attitude, attitude of trusted friends, the policy environment and the structure and impact of a range of institutions);
- *Characteristics of the innovation to be adopted* (characteristics of product or policy to be adopted).

Attempts by external organisations to impose more information on farmers’ already crowded lives may simply reinforce their sense of helplessness about a particular situation. Kaplan (2000) proposed that the general solution to this kind of problem is to develop a participatory problem solving approach to encouraging sustainable behaviours and practices. Rather than telling people what to do, the correct approach would be to provide people with an opportunity to figure out for themselves how various broadly defined goals can be met. There is evidence (Wandersman, 1979) that people in groups prefer to work with experts than on their own. Garforth *et al.* (2005) found that sustainable rural businesses, communities and economies are more likely to emerge from creative processes of identifying problems and opportunities, and developing strategies for dealing with them, than from the implementation of a package of measures developed by others.

Thus, beyond purely modelling the structure of the AKIS, attention must also be paid to how knowledge flows in the AKIS can be adapted to maximise the participation of the different sections of the farming community, especially hard-to-reach groups. I return to this later but firstly the conceptual challenge of framing policy interventions designed to stimulate agricultural entrepreneurship and innovation is discussed.

3. THE ‘DPSIR’ MODEL: A FRAMEWORK FOR POLICY INTERVENTION TO PROMOTE INNOVATION?

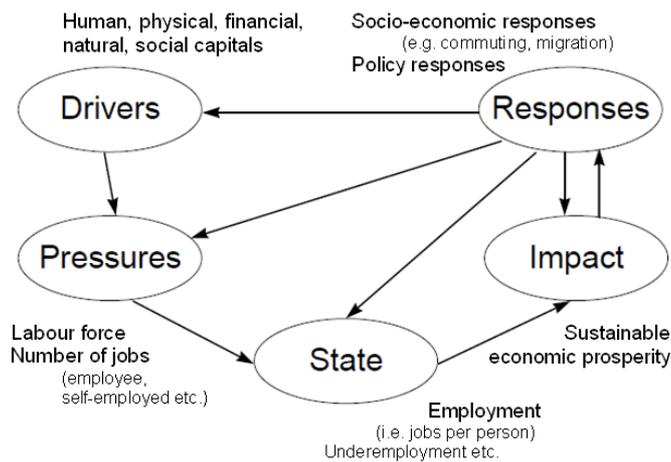
Pender *et al.* (2012) reviewed several ‘conceptual frameworks’ for wealth creation and rural livelihoods and noted that difficulties exist in linking ‘community factors’ with ‘more macro-level political factors, policies, and programs influencing them’ (p. 71). UNIDO’s enterprise development cycle model (Figure 3) is a valuable contribution to furthering our understanding of the mechanisms of innovation development but it provides only a limited understanding of how programme designers and managers can intervene to stimulate rural and agricultural innovation.



Source: UNIDO (2012).

Figure 3. Categorisation of enterprise development approaches.

To overcome this, in its work on identifying new sources of rural employment, the EU Framework 7 project ‘RuralJobs’ (www.ruraljobs.org) used the driving force, pressure, state, impact and response (DPSIR) model as a tool to show the link between driving forces which affect employment and economic prosperity, and policy responses (Figure 4). These driving forces were shown to be the ‘territorial capital’ of the area, which ‘RuralJobs’ categorised as human, social, physical, financial and natural capital after DfID (1999).



Source: adapted from Smeets and Weterings (1999).

Figure 4. The DPSIR model applied to employment.

In brief, rural employment (jobs per person of working age) represents the *state* in the model. Employment has an *impact* on economic prosperity (which is one of the four key objectives of the EU Sustainable Development Strategy) and other issues such as social cohesion, and these in turn influence policy (and other, such as socio-economic) *responses*. These responses may be targeted either at the *driving forces* which in turn influence the pressures on employment, i.e. supply of labour (working age population) and supply of jobs (economic activity), or directly at the creation of more and better jobs.

Responses can take two forms, *socio-economic* responses and *policy* responses.

For the former, where the number of jobs in a locality is insufficient, the working age population may respond by commuting to urban centres or by temporarily or permanently migrating.

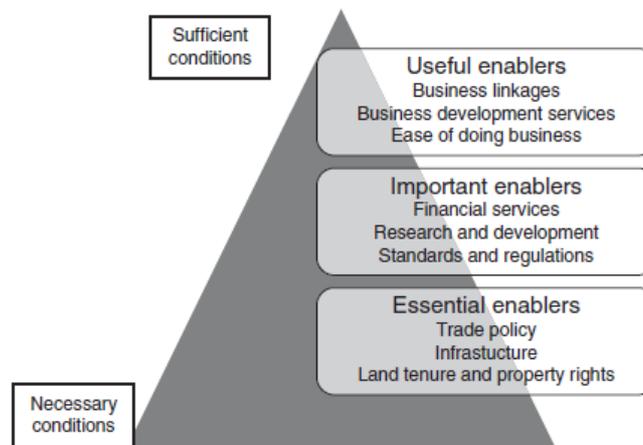
Policies to increase economic prosperity can be targeted at the *pressures* of working age population or number of jobs. For example, government proposals in several EU Member States to raise the retirement age will lead to an increase in the supply of labour. The supply of jobs can also be directly increased by government intervention, such as through subsidies for job creation (the Hungarian ‘*Út a munkához*’ programme being an example) although in many such schemes the jobs are not economically sustainable after the funding ends.

Policies can also be targeted directly at the *state* of employment (i.e. employment rate and associated factors such as underemployment) by connecting ‘offer’ with the ‘demand’, one approach being through the funding of ‘job (search) centres’.

However, the recommendations arising from the ‘Rural Jobs’ research are mainly targeted at the *driving forces* in the DPSIR framework. An approach which integrates exploiting natural capital in a sustainable way with the development of the other ‘capitals’ of the territory (i.e. via a place-based or territorial policy approach as advocated by Barca, 2009) can create jobs and encourage working age people either to stay in, or relocate to, rural areas.

The DPSIR model is not simply an abstract concept. This is a well-established model that has been widely used in the past in environmental studies (Smeets and Weterings, 1999). Its practical relevance was demonstrated by the compilation of a set of 40 indicators drawn from several major programmes and strategies (Fieldsend, 2010). Fourteen indicators of driving forces include *Educational attainment* (human capital), *Business investment* (financial capital), *Crime rates* (social capital), *Internet infrastructure* (physical capital) and *common bird index* (natural capital). There are four indicators of pressures (*Population*, *Population density*, *Number of jobs*, *Jobs density*) and six indicators of state (*Activity rate*, *Employment rate*, *Unemployment rate*, *Long term unemployment rate*, *Employment by sector*, *Status in employment*). Impact is measured through *Personal income*, *Inequality of income distribution*, *Housing (crowding)* and *Motorisation rate*. A further eight indicators of state cover topics that are much less easy to measure such as *Time related underemployment*.

It would be worth exploring if the DPSIR model can also be used to strengthen our understanding of the relationship between rural and agricultural innovation and policy responses. Could ‘innovation activity’ be defined as the *state* in the model? As in Figure 4, it might be anticipated that the *impact* of innovation activity could be measured as ‘economic prosperity’, and that the level of prosperity would influence policy *responses*. Clearly, policy responses could be targeted at any point in the model, but an important focus may be on developing ‘innovation culture’ in a community or territory as a *driving force*. Innovation culture can then lead to an increase in ‘innovation skills’ or ‘human capital’, which could be seen as a *pressure* that drives ‘innovation activity’.



Source: Christy *et al.* (2009).

Figure 5. Hierarchy of enabling needs for agri-industry competitiveness.

One policy approach to developing an ‘innovation culture’ is to improve the ‘enabling environment’ for innovators. Christy *et al.* (2009) developed a hierarchy of enabling needs that a government can consider in addressing its role in advancing economic progress (Figure 5). At the base of the pyramid, the state must provide *essential enablers* that will make possible the function of markets and enterprises. Items such as the rule of law (e.g. contract enforcement, property rights), the provision of infrastructure and a conducive trade policy can be placed in this category. So-called *important enablers* are second-order activities that the state can and often does provide, such as norms, standards and regulations, financial services, and research and development. Finally, Christy *et al.* (2009) define *useful enablers* as sufficient but not necessary conditions to include business regulation, linking small farmers to formal markets and business development services.

Various tools exist (e.g. SWOT analysis, SOR analysis) that can be used to further understand the relationships between the different components of the DPSIR model (Fieldsend, 2013).

4. THE EIP 'AGRICULTURAL PRODUCTIVITY AND SUSTAINABILITY'

The European Commission (EC) is presently setting up the European Innovation Partnership (EIP) 'Agricultural Productivity and Sustainability' that will serve as a catalyst to enhance the effectiveness of innovation-related actions in agriculture during the 2014–2020 programming period (EC, 2012). The overall objectives and proposed structure of the EIP are widely known and need not be described in detail here.

Two major forums are being used by the EU for consultation about the EIP. One is the Standing Committee on Agricultural Research (SCAR) Collaborative Working Group on AKIS, author of SCAR (2013) which is currently in press, while the other is the Focus Group on Knowledge Transfer and Innovation which is composed of representatives from EU Member States' national administrations, National Rural Networks, and EU organisations and academics. The Focus Group (ENRD, 2013) deducted several relevant lessons from a set of case studies it collected that identify some activities that can encourage the development of an entrepreneurial culture:

- *Animating the potential innovators.* Very often the stakeholders have already conceived a possible innovation but they lack knowledge and support in order to proceed;
- *Advisory services and 'innovation brokers' play a key role in the innovation process,* acting as facilitators in a process with a high level of complexity and multiple actors involved;
- *Good communication and cooperation and building trust between the various actors* are fundamental for success in this interactive process;
- *Assessing market needs* is a precondition for innovation. Understanding the market changes and trends is an important condition for identifying the domains for innovation;
- *Combining different funds and different measures* enables implementing more complex projects and making use of different options available;
- *Building the right partnership* is important by bringing together the right partners who have the motivation, skills, knowledge on the subject and are willing to invest into a successful partnership;
- *A local business model* is required, which will be adapted to the local specificities and incorporates the economic, social, and cultural characteristics of the area;
- *Ensuring the flexibility of authorities and regulations,* on how the rural development policy is implemented and supports the innovation process;
- *Managing risk and handling failure,* as risk taking and the possibility of failure are integral parts of the innovation process;
- *A clear framework for innovation* is also important for defining the measures and conditionality which can lead to innovation.

These guidelines are relevant to the establishment of Operational Groups (OGs) that are expected to be the main ‘delivery mechanism’ under the EIP. OGs build upon a tradition where innovative farmers develop successful new practices, products and services or machinery and even software. The idea is that, using the ‘participatory’ network approach to forming partnerships, OGs will result from bottom-up initiatives arising from the needs and opportunities identified by farmers themselves, and bring together farmers, advisors, researchers, businesses and other actors into groups to develop innovative solutions. This ‘multi-actor approach’ is expected to ensure the necessary cross-fertilising interactions between actors in the AKIS. The key feature is that the forming of OGs shall take place on the initiative of innovation actors. No specific conditions are laid down by the EC as regards the size, the composition and the specific undertakings of an OG.

In the framework of the DPSIR model, therefore, in view of the perceived need to improve the innovativeness of agriculture and the socio-economic development of rural areas (*impact*), OGs, via the EIP, may therefore represent an example of a policy *response* intended to establish an ‘innovation culture’ (or at least framework) in agriculture as a *driving force* that will stimulate ‘innovation activity’ (*state*) via an increase in (the mobilisation of) ‘innovation skills’ (*pressure*).

A note of caution is appropriate here. Gorton *et al.* (2009) and Swain (2013) have pointed out that EU agricultural policy has been tailored to the predominance of (medium-sized) family farms, but that agriculture in the eastern EU Member States is characterised by a historical absence of such farms. Thus it remains to be seen if the EIP can be effectively implemented in post-transition AKIS such as in Romania and Hungary.

5. CASE STUDY: AGRICULTURAL DEVELOPMENT IN THE EASTERN REGION

The Agricultural Development in the Eastern Region (ADER) project was implemented in the East of England between 2001 and 2007. It was set up at a time when farmers in the region were facing radical business choices about either leaving the industry, re-skilling, diversifying or adjusting farming practices in response to the then-new agri-environment incentives arising from the reform of the Common Agricultural Policy. ADER focused on helping farmers, by means of skills development programmes and business support, to identify new opportunities and develop alternative business activities (Murphy, 2012).

During its existence ADER supported over 4,000 one-to-one clients and nearly twice that number of group attendees. In 2009, 48 per cent of farms in the region were estimated (Keep 2009) to have diversified enterprises (i.e. approximately 4,000 farms), thus a large percentage of these will have used one or more services offered by ADER. A record of ADER case studies shows that 47 per cent of the supported businesses were involved in adding value to farm production in

the form of new products, farm shop outlets and marketing initiatives. Another 33 per cent were not related to farm production but used existing buildings for diversification activities such as holiday accommodation, children's nurseries, a hat shop and upholstery work. The remaining 20 per cent were involved in equine and wildlife and conservation projects. These results suggest that ADER, including its facilitated group learning activities, significantly contributed to supporting innovation amongst farmers in the region. Two key features of ADER underpinned its success:

Firstly, it was jointly developed by the Regional Development Agency (EEDA, as the main funder) and a group of land based Higher Education Colleges (which provided the service), and was endorsed by industry organisations (such as the National Farmers' Union, NFU) which helped to secure political backing and funding and promoted the project to their members. As a result, the project quickly gained the trust of the farming community and the level of farmer engagement was high.

Secondly, although ADER provided one-to-one business support to farmers, the experience of the team was that this one-to-one support was not the most successful method in creating real change in farmers' attitudes and behaviours. Instead, the facilitated group learning (i.e. small group seminars) proved to be a more sustainable method in creating attitude and behaviour change in land managers and therefore more sustainable development in the rural community, even though it was perhaps less easy to report that information in a quantitative way to funding bodies.

More generally, Murphy (2012) identified five lessons learned from the ADER project:

- *Be flexible*: ADER needed to be flexible and responsive to keep in touch with changing farmer needs;
- *Focus on farmer based promotion*: using farmers wherever possible to promote the programme;
- *Choose tutors and advisors carefully*: Farmers are very sceptical about the motives of professionals and tutors and advisors;
- *Provide a choice over timing and delivery location*: Farmers are much more receptive to support which takes into account the farming calendar and which is delivered locally.
- *Find ways to engage 'at risk' groups*: Anecdotal evidence suggested that traditionally those farmers who are most in need of help to change direction are often the least willing to accept it.

Although ADER represented a different concept to the OGs of the EIP, it has two characteristics in common with them. One is that it combined agricultural *extension* with the other three components of AKIS (*research*, and *education and training* through the agricultural colleges and *support systems* such as EEDA and the NFU). The other, the facilitated group learning approach, recognises that

people (including land managers) like to feel in control of their lives. This rationale that proved to be effective in the ADER project is applicable to the approach being adopted by the EIP and also has application in other situations.

6. DISCUSSION AND CONCLUSIONS

All of the above topics are relevant to the current challenge of facilitating agricultural innovation in the EU. Firstly, the concept of AKIS is valuable in illustrating the wide variety of actors that can contribute to rural (agricultural) innovation and entrepreneurship. It is, however, a concept that is still in its infancy and the model is still being developed. Alongside the concept itself, it is equally important to understand (a) that innovation in agriculture depends on using different types of knowledge (lay/tacit/codified/scientific etc.) (Dockès *et al.*, 2010) and (b) how information, knowledge and advice flows through the AKIS. In the context of both of these points, the currently widely held view is that a ‘top-down’ approach to stimulating innovation is not as effective as a participatory approach. Engagement of hard-to-reach groups, semi-subsistence farmers being a good example, is a continuing challenge.

Another challenge is how to better understand the links between policy formulation, entrepreneurial activity and economic prosperity. The DPSIR model could potentially be used for that purpose and this paper has shown how it can be applied to the EIP ‘Agricultural Productivity and Sustainability’. An interesting exercise would be to try to interpret the enterprise development cycle illustrated by UNIDO (2012) in the context of the DPSIR model. A cursory assessment is that it focuses on promoting ‘innovation (entrepreneurial) culture’ (*driving force*) and thus ‘innovation (entrepreneurial) skills’ (*pressure*). If so, it would appear to fit to the DPSIR model of being a form of policy intervention designed to enhance economic prosperity by increasing rural innovation. *Access to finance* and *access to markets* illustrate the relevance of improving the ‘enabling environment’ as part of a holistic approach to encouraging innovation and entrepreneurship.

The EIP ‘Agricultural Productivity and Sustainability’ builds heavily on the concept of AKIS and of participatory approaches to generating innovation. It remains to be seen, however, how effectively it operates outside of a western European model of agriculture. There is sufficient evidence to suggest that this is a potentially serious problem. The work reported by Murphy (2012) that identified at least five sets of non-financial variables influencing farmer behaviour echoes the set of ‘adoption predictors’ categorised by Hartwich and Scheidegger (2010) as (a) adoption of innovation technologies, knowledge etc.; (b) access to and endowment with resources; (c) socio-demographic factors; (d) socio-psychological behaviour; and (e) communication. At the very least it must be anticipated that a considerable proportion of farmers will not willingly engage with this process. The EIP will hopefully prove to be one successful means of stimulating rural (farming) innovation, but it cannot be expected to be a ‘one size fits all’ solution.

The Agricultural Development in the Eastern Region project implicitly adopted the concepts of AKIS and a participatory approach to learning and stimulating farmer innovation in an approach that was strongly farmer-focused. It provides an example of how some of the concepts discussed earlier in this paper can be successfully applied in practice. In pursuit of ‘sustainable intensification’ there is an urgent need to develop further models for encouraging agricultural innovation in other farming situations, such as those in eastern central Europe.

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