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CHANGES IN AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEMS: CASE STUDY OF POLAND

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The paper has analysed and evaluated the existing concepts of relations between science and education, advisory services and agricultural practice in the aspect of strengthening competitiveness of the agricultural sector of the EU and also has identified the most important elements of agricultural knowledge system (AKS) in Poland and the assessment of their relationship. The source material was literature review on the subject, statistical data and quality assessment of the relationship between stakeholders achieved as a result of a two-day panel discussion. The results indicate that the traditional concepts of linear links between science and agricultural practice are replaced with innovative concepts of networking. In Poland, there is not yet a well-functioning system of agricultural knowledge. Despite the existence of all the links in the classical system of knowledge existing links between them are highly varied. Very strong links exist only between agricultural advisors and farmers, strong between advisory, and research & education, between advisory and agricultural policy, and between farmers and companies selling agricultural inputs and purchasing agricultural products. Other links have been identified as weak.

Keywords: transfer of knowledge, information, innovations, knowledge systems, models of relations science-practice

Introduction

The central element under the Europe 2020 Strategy, which is intended to promote intelligent and permanent economic growth favouring social inclusion are innovations. Under the current Common Agricultural Policy (CAP) it is perceived as the key factor supporting sustainable agriculture and development of rural areas. The most important challenges and opportunities related to sustainable production and development of rural areas include: protection of biodiversity, ensuring profitability, using biomass, bioenergy production, counteracting climate changes, resources management, food safety and food security (Europe, 2020, 2010).

Innovations can be understood in many ways. They can involve new and improved products, processes, techniques and technologies, services or their adaptation to new requirements, e.g. environmental. The new idea is defined as innovation only if it becomes commonly applied in a given domain, namely when it brings specific results. A necessary factor propelling successful innovations in the contemporary world are interactions among farmers, scientific employees and advisors (Moreddu and Poppe, 2013).

Interactive innovation model, based on voluntary participation of entities within the group project, is supposed to be the main principle of knowledge transfer in the future. This model focuses on the departure from top – down use of science and technology to increase technical effectiveness and moving towards social innovations, which are characterised by pursuit to achieve permanent benefits through new forms of cooperation (Koutsoursis, 2012).

Innovations have a gap between scientific research and practice, i.e. scientists' inventions are not used to a sufficient extent and often scientists are not dealing with matters important for farmers (Van den Ban, 1997).

A priority in the innovative EU policy for the years 2014–2020 is connection of the policy in scientific research and policy for development of rural areas, which is proven by e.g. operational programmes Horizon 2020 and RDP 2014–2020 (priority 1. "Fostering knowledge transfer and innovation in agriculture, forestry and rural areas").

Material and methods

The paper has analysed and evaluated the existing concepts of relations between science and education, advisory services and agricultural practice in the aspect of strengthening competitiveness of the agricultural sector of the EU and also has identified the most important elements of agricultural knowledge system (AKS) in Poland and the assessment of their relationship. The basic research question was how cooperation between AKIS stakeholders is assessed from the standpoint of ODRs.

The source material was literature review on the subject, statistical data and quality assessment. Initial qualitative assessment about the strength of the cooperation between the ODR and other stakeholders was made independently in each of the ODR by subject matter specialists and management staff (6–9 persons) in a four-level scale ratings (lack of cooperation, weak, good, very good).

In the final discussion during two-days panel organized in the Agricultural Advisory Centre in Krakow, directors from 16 provincial Agricultural Centres, the representatives of 16 Social Councils for Agricultural Extension – mainly famers and 17 scientists from agricultural universities and research institutes took part – jointly 49 people. The panel participants were acquainted with these assessments that have been discussed and finally expressed their opinion in relation to other ODRs using the method of consensus.

Research findings were presented using the text, tables and figures method.

Knowledge transfer process – application of research in practice

Transfer of knowledge is defined as a unidirectional flow of knowledge from science to practice including different groups of potential customers as e.g. farmers, entrepreneurs, advisors, managers, decision-makers, the transfer of which is the responsibility of scientists (Van den Ban, 1997; Anderson, 1992).

Knowledge transfer methods may be active or passive, depending on the goals of knowledge transfer. There are three types of knowledge transfer used by researchers (Lomas, 1993; Rynes et al., 2001; Johnson, 2005):

- Diffusion – aims at the promotion of knowledge, namely creating the awareness of this knowledge among potential recipients. Knowledge is at this point available through magazines, bulletins, websites and mass media, and usually it is not directed at specific customer groups. The goal of this type of knowledge transfer is spreading information outside a particular scientific institution;

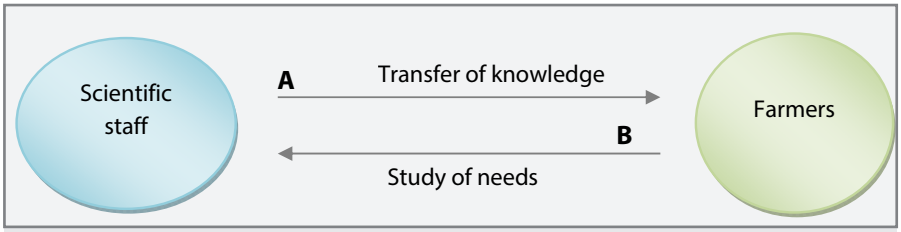

Figure 1 Transfer of knowledge directly from science to agricultural practice in the system of two stakeholders in the model of transfer of technology (A) and in the model of social interaction (B)
Source: own research

- Dissemination – includes purposeful actions, consisting in sharing research findings among specific recipients through sending research findings and invitation to participate in seminars and conferences. The aim is both creating knowledge among specific groups of recipients and change in their behaviour;
- Implementation – the most active transfer of knowledge aiming at change in the behaviour. Implementation strategies include efforts to break various barriers among recipients. Implementation of research findings takes place through individual contacts of scientists and/or advisors with farmers, or the analysis of effects from the conducted experiments, field demonstrations and pilot projects. It is made to change the attitude of potential recipients to modern knowledge and innovation.

In literature on the subject there are two main knowledge transfer mechanisms, i.e. information and interaction (Becheikh, 2010).

Information mechanisms include research reports, scientific articles, professional journals, information reports, manuals, training materials, blogs, websites etc.

Creating central or regulated databases concerning innovative solutions, best production practices and platforms of knowledge exchange may be a solution leading to better knowledge management and its transfer.

Interaction mechanisms include methods of obtaining and dissemination of knowledge by interpersonal communication. They include lectures, conferences, seminars, workshops, trainings, discussions, meetings, study visits and different social actions.

Flow of knowledge transfer is the main problem in improvement of agricultural, production, environmental, hygienic and other practices. Currently, although modern information and communication technologies facilitate access to research findings to the employees of the production sphere, there is still a huge gap between the knowledge created by scientists and agricultural practice. The reasons for the existence of this gap are attributed mostly to the scientific staff members who often focus their interests, time and effort on creating knowledge rather than dissemination of their research findings (Anderson, 1992; Van den Ban, 1997). This causes the main barrier in diffusion of research findings to managers, decision-makers and producers.

Other authors (Kirst, 2000; Hemsley-Brown and Oplatka, 2005) search for the reasons for this gap among representatives of agricultural practice. These include conservatism and distrust to implement new knowledge, low competences and poor perception. Among features of innovation recipients in the context of knowledge transfer the following are important: motivation as regards the use of knowledge, the degree of distrust to external knowledge, compatibility of their goals with the goals of agricultural policy and good agricultural practices and having relevant financial, tangible information and human resources (Griffin, 2004).

In the process of knowledge transfer from science to agricultural practice it is possible to observe substantial gap, therefore tremendous amount of knowledge generated by scientists does not reach or reaches with a great delay final beneficiaries, namely farmers. A critical role in this process is played or may be played by advisors, presently called knowledge brokers. Their task is maintaining close contacts both with scientific staff and farmers. They should constitute a platform enabling better interaction between scientists and farmers. In the European Knowledge and Information (Innovation) Systems advisors pose a very important link in the process of knowledge transfer. They are required not only to have perfect professional knowledge (general and specialist in a given field), methodical and interpersonal communication, but also systematically improve it and gain practical experience, which requires time. At the same time, it is worth noting that practical training on higher agricultural studies (professional internships, field classes, study visits, participation of practitioners in lectures) is highly imperfect, which is confirmed by reports and research findings of many Polish authors (Wawrzyniak and Wiatrak, 1999; Rudnicki, 2013).

Acquisition of experience is also the participation of advisors in scientific conferences, seminars and thematic workshops.

Many advisors perceive scientists as those who belong to the world of theory, which is distant from the problems of agricultural practice, which are not undertaken by them. It is very important to try more strictly to link the worlds of science with agricultural practice to level the existing gap in the knowledge of transfer system by creating better atmosphere of cooperation and new relations (Hemsley-Brown and Oplatka, 2005).

Figures from 1 to 3 feature graphically linear transfer of knowledge from science to agricultural practice using the model of transfer of technology (TOT) and the model of social interaction. Linear

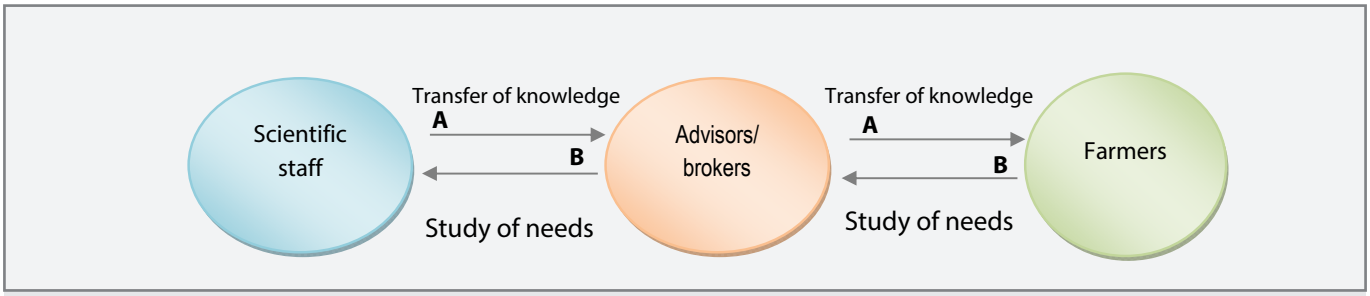

Figure 2 Transfer of knowledge from science to practice by advisory in the system of three stakeholders in the model of transfer of technology (A) and in the model of social interaction (B)
Source: own research

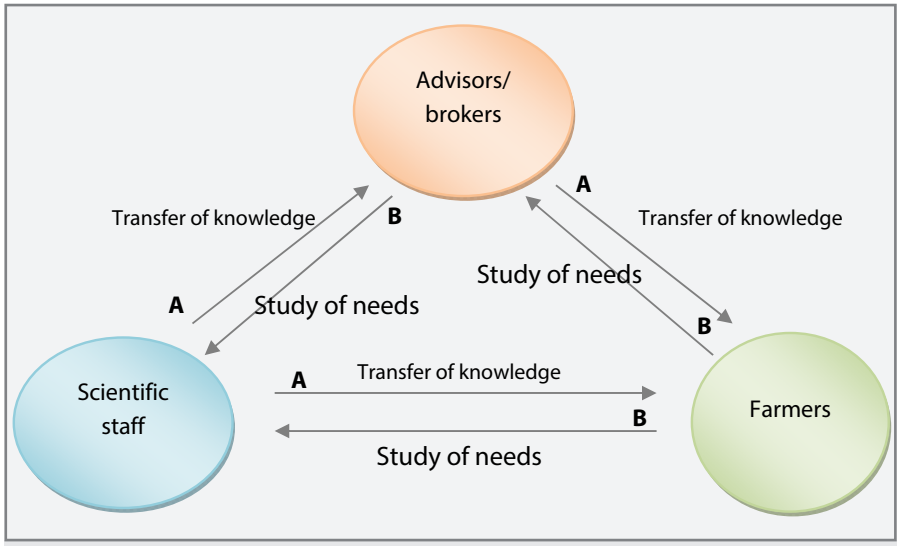

Figure 3 Alternative transfer of knowledge from science to practice in the system of two or three stakeholders in the model of transfer of technology (A) and in the model of social interaction (B)
Source: own research

approach to transfer of knowledge means approach based on science and scientific research, where new ideas resulting from research findings are introduced into life by unidirectional (linear) flow of knowledge.

A different approach to transfer of knowledge and information is the interactive approach, in which component elements of good information or innovative solution may come not only from science, but also from farmers and other stakeholders of the system of knowledge.

Systems of agricultural knowledge and information as well as models of transfer of knowledge in agriculture

In economics, knowledge is treated as "the resource needed to gain profit" (Adamowicz, 2005). According to this view, each farm operates under the knowledge possessed. The European Union attaches great importance to progress and continuous creation of knowledge, however, in the world of scientific-technical race, the EU starts lagging behind the leaders. For this reason, it is more and more strongly emphasised to treat the research and development sector as a priority. In the light of the above, also the need for improvement in the methods of transfer of knowledge within the systems of knowledge and agricultural information is observed (Moreddu and Poppe, 2013).

The concept of system of agricultural knowledge was established in the 1960s. It is a consequence of intervention policy of the states which modernised agriculture and wanted to accelerate the transfer of knowledge into agricultural practice through strong integration of science, education and advisory, most often at the national level, implemented by the Ministry of Agriculture. Slightly later, namely in the 1970s, such organisations as OECD and FAO introduced the concept of the system of knowledge and information in the political discourse, which subsequently evolved towards agricultural innovation systems and at present, towards learning and innovation network and the European Innovation Partnership. They are defined as follows:

System of agricultural knowledge – a set of participants (actors), such as scientific staff, lecturers and advisors working in the sector of agriculture. In this system, focus is put on the creation of agricultural knowledge under national research systems. Research findings are then transferred into agricultural practice by organisations of agricultural extension (Rudman, 2010).

System of knowledge and agricultural information – classic definition describes it as "a set of institutions and agricultural organisations and/or people and relations and interactions between them, involved in the creation, gathering, selection, processing, transferring and the use of knowledge and information for sustainable agricultural development by supporting the decision-making process and problem solving" (Rolling and Engel, 1991). This concept developed the notion of system of agricultural knowledge by directing the main stress on the process of creating knowledge and considering in it other participants of the system apart from learning, education and advisory.

A more contemporary system is the agricultural knowledge and innovation system, which is of greater importance since opening to greater execution of public tasks and focusing on innovations (Klerks and Leeuwis, 2009). The key importance for the efficiency of AKIS is networking and cooperation among scientific institutions, advisory organisations and farmers. Hence, the emergence in the last 20 years of agricultural innovation systems.

Agricultural innovation systems – these systems are defined as "networks of organisations, companies and natural persons focused on the introduction of new products, new technologies and new organisational forms to economic use and which together with public institutions and agricultural policy affect the way individuals communicate, share and exchange knowledge and use it" (Leeuwis and Van den Ban, 2004).

Network approach is also represented by the concept of learning and innovation for sustainable agriculture. It is characterised by thematically focused networks of learning of various partners, both those being members of the networks and from outside. These can be farmers, advisors, scientists, public administration employees and others stakeholders (Rudman, 2010). Focus in this concept is put on creating, learning and innovation by interactions between the members.

The difference between agricultural innovation systems and networks of learning and innovation consists in the conceptualisation of knowledge. In the first one knowledge is perceived as a "resource to be transferred", while the network emphasises the processes necessary, so that knowledge is useful and possible to be applied by other participants.

As it can be noted, these definitions are characterised by the evolution of thinking; from the system of agricultural knowledge to agricultural innovation systems as a process of gradual questioning of linear transfer of knowledge (from science through advisory to practice and vice versa) towards more complex and network-based vision of the creation of knowledge, learning and undertaking innovative actions. These new concepts reach out to progress in agriculture and sustainable development of rural areas.

Subject literature proposes many models of transfer of agricultural knowledge and its use. The best known ones are Havelock models (1973), spread and developed in many scientific publications (Huberman, 1983, 1990, 2002; Van den Ban and Hawkins, 1997; Kania, 2007; Chambers and Jiggins 1986).

Neville and Warren (1996) divide these models into 4 groups:

- transfer of technology models (e.g. ToT – Transfer of Technology, RDD – Research, Development and Diffusion). In Poland they are known as the research-development-implementation-diffused models, including: basic research, use, development of techniques and technology of production, implementation and dissemination,
- models of social interaction,
- models of problem solving,
- network models.

1. Models of transfer of technology

The starting point is preparation of new technology in the scientific-research unit and then its implementation and diffusion in practice. Flow of information takes place in this traditional model from the scientific-research unit to the centre of agricultural extension and the farmer, top-down (Figure 4). Science in this model serves as the "force pump". The employee of the scientific-research unit is the initiator of research, the executor and the person responsible for the promotion and diffusion as well as implementation of his/her research findings (Lavis et al., 2003). The disadvantage is its lack of flow of feedback from farmers to advisors and scientists, which at present is associated with marketing survey among advisory customers, namely examination of their needs and expectations. This model additionally takes no account of the role of sociological and psychological research, agricultural and economic policy as well as the functioning of the whole institutional environment of the agriculture and rural areas.

Scientists and advisors act in the model of ToT as specialists and experts, fascinated by the knowledge possessed and their research findings, who want their customers to adjust to the offered information or advice. Information or the way of its transfer cannot be questioned due to their high social status. A frequent question of scientists/advisors is: "Why don't they (farmers) apply what we propose?". And without adjustment of information and advice to the needs and opportunities of a given farmer and the knowledge of their personal characteristics, the effectiveness of transfer of knowledge and information is usually low (Boland, 1995).

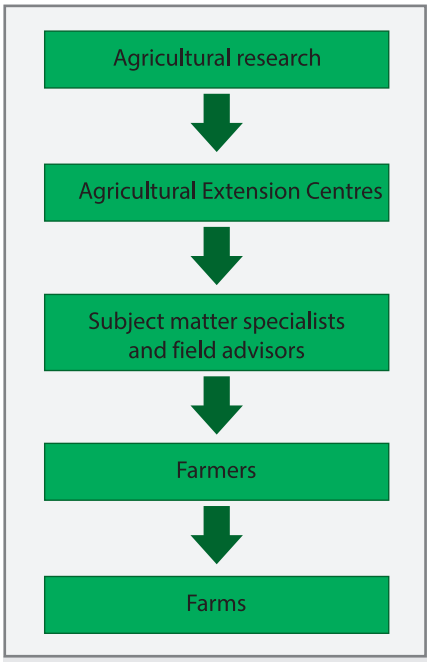

Figure 4 Simplified scheme of knowledge and information flow in the research, development and diffusion model
Source: Van den Ban A.W. – Hawkins H.S. 1997a. Doradztwo rolnicze, Wyd. I polskie. MSDR, Kraków

2. Models of social interaction

Classic flow of knowledge and information in the model of social interaction is presented in Figure 5. This model uses the Rogers' theory of diffusion of innovations (Bunting, 1986; Röling and Engel, 1991) and feedback from the farmers to advisors, scientists and politicians and, first of all, customer needs and expectations of advisory customers are taken into account. Practice in this model serves as a "suction pump" – agricultural organisations, managers, farmers or groups of farmers order research and contract expert's reports, to apply their results in practice.

The model of social interaction deals with marketing approach to the research on the needs of transfer of knowledge, namely a specified form and method of agricultural advisory is adjusted to a specific recipient or a group of recipients, who respond to innovations in various ways. According to the theory of diffusion (Rogers, 1983), among the group of recipients receiving agricultural innovations for the first time there are innovators, constituting 2.5% of the population, early adopters also called pioneers, progress farmers and at present leaders being the so-called "right hand" of advisors, being 13.5%, early majority – quite progressive farmers, also called imitators – 34%, late majority – quite traditional farmers – 34% and laggards – tardy – 16%. The ability of the adviser is to recognise particular groups of recipients among the population of farmers in the area of their impact, especially the selection of a group of opinion leaders, may perfectly facilitate transfer of knowledge and information and increase the impact on other groups of farmers.

A different model of social interaction is reflected by the concept of the Agricultural Knowledge and Information System prepared by the World Bank (Swanson, 1997), which is illustrated in Figure 6.

Analysis of stakeholders comprising the Agricultural Knowledge System indicates that each of these system elements is more or less connected with the other ones. For this reason, it is believed that every change in one cell of the system must provoke a specific effect in the remaining cells, and vice versa. For example, one cannot claim that science is able to solve all issues of food shortages in the world, or that only a good agricultural extension service system may effectively make use of the results of scientific research. All cells are important and they must co-operate so that the development of agriculture and rural areas works according to the strategic assumptions of agricultural and structural policy.

Therefore, advisory service cannot function for its own sake, separately from other cells of

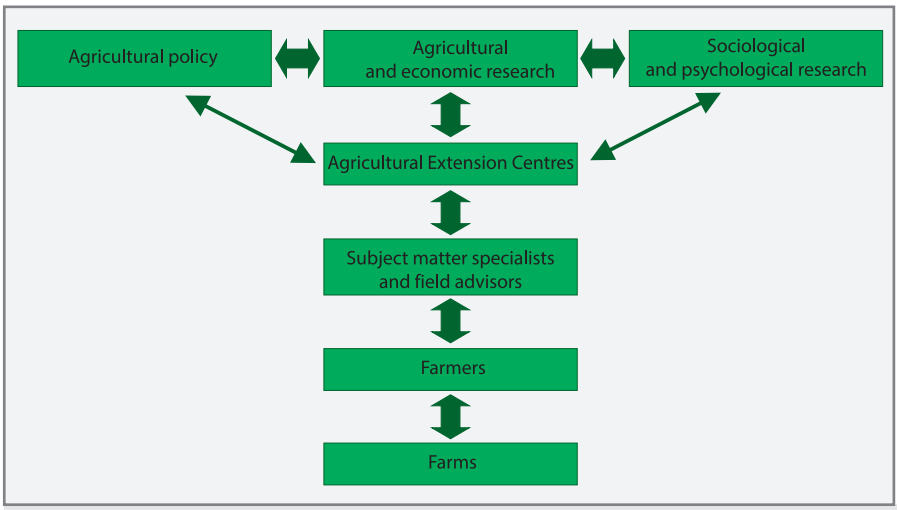

Figure 5 Simplified scheme of knowledge and information flow in the social interaction model
Source: Van den Ban A.W. – Hawkins H.S. 1997a. Doradztwo rolnicze, Wyd. I polskie. MSDR, Kraków

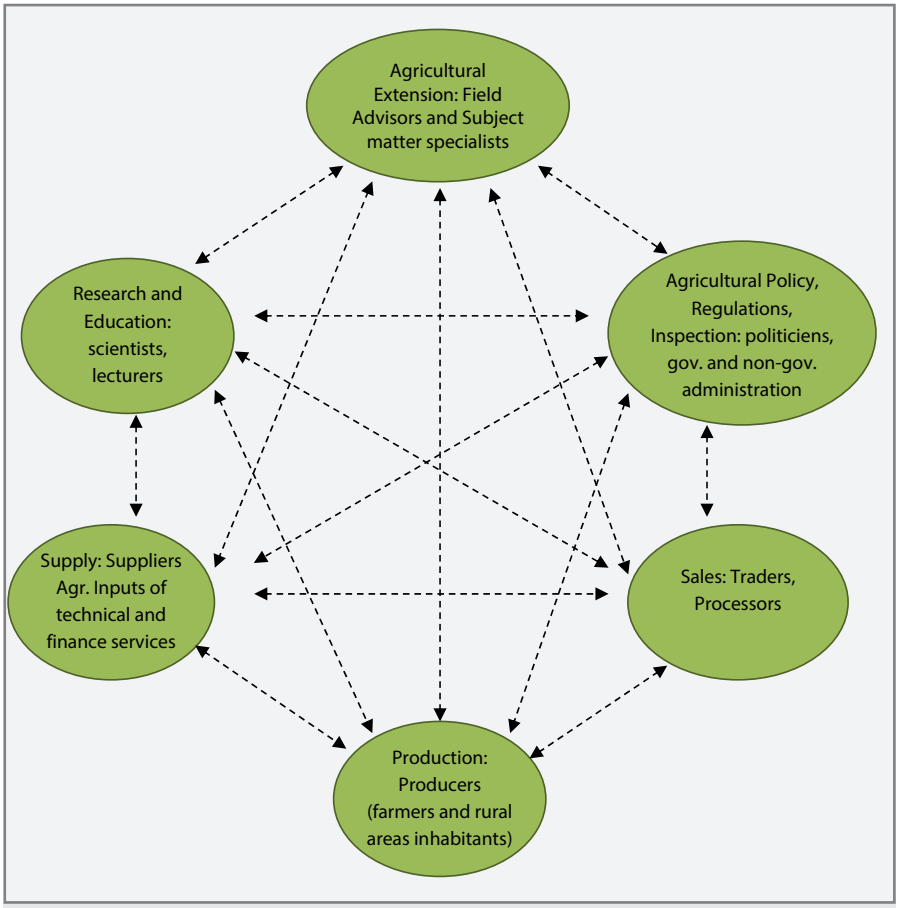

Figure 6 Functional links and their relations In the Agricultural Knowledge and Information System
Source: Swanson B.E. 1997. Strengthening research – extension – farmer linkages. In Improving agricultural extension. A reference manual. Red. B.E. Swanson, R.P. Bentz, A.J. Sofranko. Chapter 19, 171–178, FAO, Rome, Italy

the Agricultural Knowledge and Information System. Cooperation is vital, so that it can fully realise its potential. It is also impossible to improve the advisory service system itself without enhancement of the system of scientific research and the mechanism connecting it with the advisory services, and the advisory service management cannot be improved without involvement of farmers in its program and evaluation of any obtained results.

3. Models of problem solving

In the concept of transfer of knowledge under the conditions of market economy, great attention is paid to models of problem solving using a classic approach, in which the problem is solved by advisors/scientists or the participating approach. In the participating approach, scientists and representatives of the agricultural practice cooperate over the identification of research problems adequate to their needs and skills, share information, knowledge and experience.

The starting point in the model of problem solving is the problem of a farmer or a group of farmers, initiated by them or by an advisor, rather than research findings or agricultural innovation. A given problem is solved by an advisor/scientist or together by an advisor/scientist and the farmer on the basis of partnership-based cooperation and the final decision with regard to the application of a given solution is made by the farmer.

In the case of using methods of group advisory it is important to bear in mind to combine farmers in the so-called target groups – groups of farmers having the same or a similar problem. Their involvement together with the advisor or scientist in the process of solving a given problem usually brings very positive effects.

In a typical model of problem solving there are 5 stages, i.e. identifying needs, defining a problem, seeking solutions, selecting the best solution to the problem and implementing the selected solution into agricultural practice (Van den Ban and Hawkins, 1997).

4. Network models

Networking is an action enabling establishing contacts, exchange of views, and access to information, cooperation and interaction facilitating achieving the expected results. The conditions of network functioning are common goals, clearly identified problem, sovereignty of network members, voluntary participation, activity of members, division of responsibility and clearly identified principles of functioning. A specific feature of a network is the type of organisational structure of the team characterised by the following features: lack of hierarchy, lack of management body, lack of subordination, domination of information bonds and cooperation bonds, temporary nature of arrangements concerning obligations, specialisations resulting from interests and professionalism and minimum

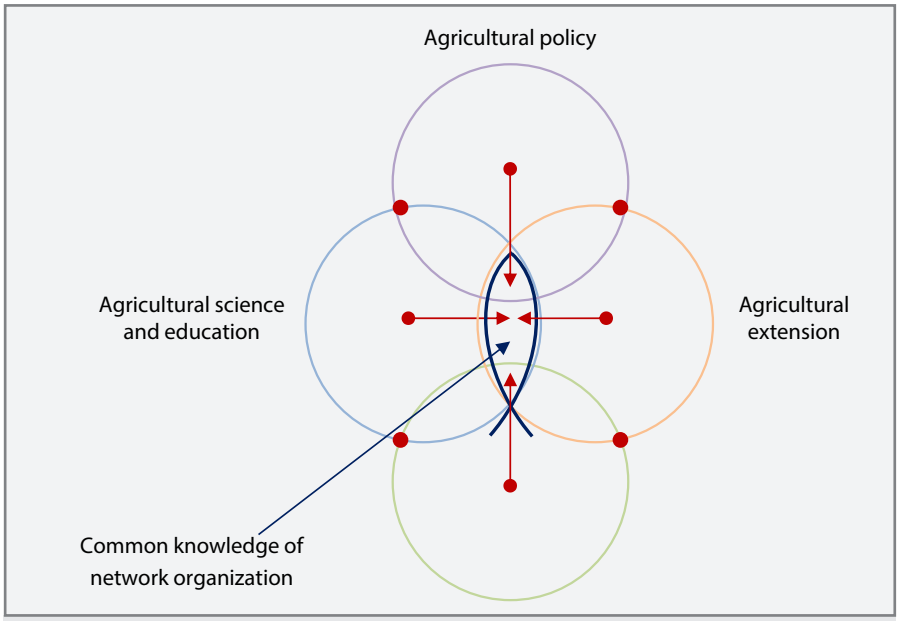

Figure 7 Decomposition of knowledge: knowledge of stakeholders and common knowledge of the innovation network system
Source: Shin S.K. – Kook. W. 2014. Can knowledge be more accessible in a virtual network?

degree of formalisation of the procedures of action (Sieci/Elsner (ed.), 2013).

Kijewska (2014) distinguishes the following kinds of network:

- networks of links with the dominant role of companies of business-business type, e.g. clusters,
- networks of relations of institutions generating knowledge of science-business or science-science type,
- networks of connections between authorities: government authorities-local government authorities, local authorities-local authorities, local authorities-intermediary institutions and participating in financing innovation.

Among the business-related institutions supporting transfer, the following can be distinguished: regional development agencies, science-technical parks, entrepreneurship incubators, entrepreneurship centres, centres of technology transfer, innovation platforms. The concept of creating common knowledge under cross-linking of various entities (stakeholders) including knowledge brokers is presented in Figure 7.

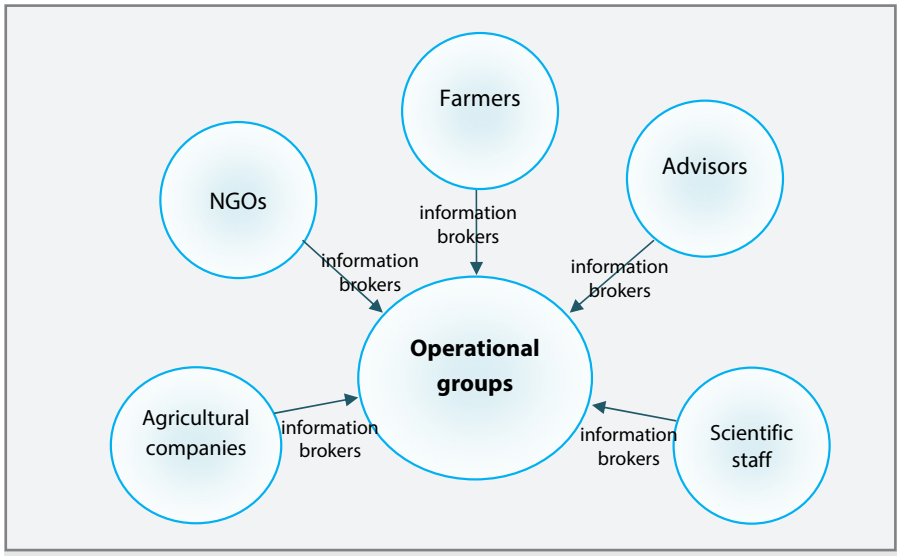

Figure 8 Creation of operational groups
Source: Review of rural areas of the EU no. 16 (summer 2013). Magazine of the European Network for Rural Development

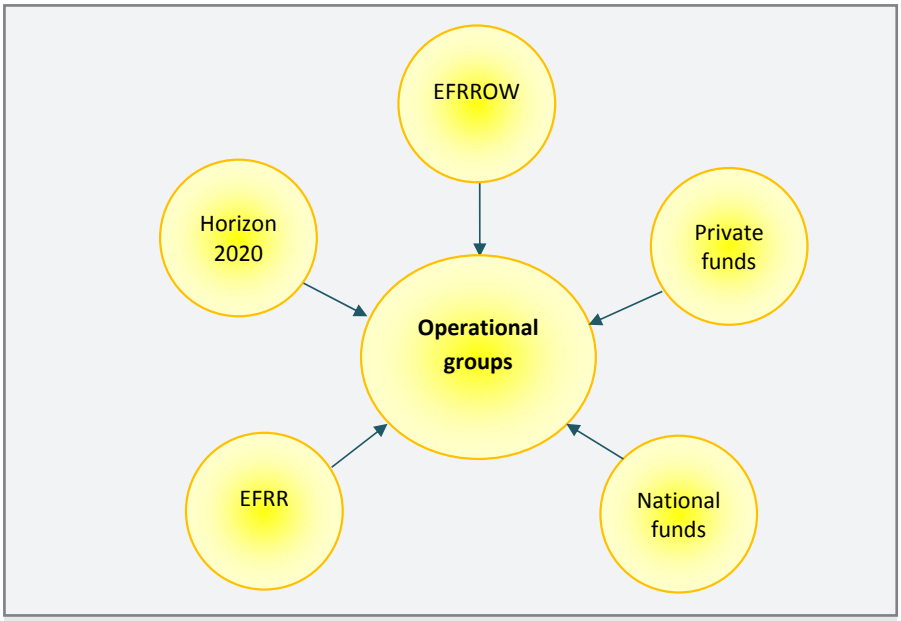

Figure 9 Financing operational groups
Source: Review of rural areas of the EU no. 16 (summer 2013). Magazine of the European Network for Rural Development

Integrated communication of particular entities is to lead to creating common knowledge of the innovation system. Considering knowledge brokers is supposed to improve the process of communication.

In the new financial perspective for the EU 2014–2020 emphasis is put on innovative partnership regarding sustainable agriculture, water resource management, agricultural raw materials, local community development, health etc. European Innovations Partnership constitutes a new, bottom-up approach to research and innovation in the social aspect (Rozporządzenie/Regulation..., 2011).

Creating operational groups under EIP in the new budget period of the EU – RDP 2014–2020 aims at the promotion of knowledge exchange bound by innovations and facilitating interaction between scientific research and agricultural practice. Two areas of the EU policy are of key importance for the implementation of this partnership: CAP 2nd pillar and the EU Framework Programme for Research and Innovation (Horizon 2020). Innovative solutions, created under network are created under interactive approach, in which the components come not only from science, but also agricultural practice and other stakeholders. They usually apply to the identified problems, for which operational groups are developed. Entities (stakeholders) involved in projects become the co-owners of the solutions, which results in the fact that they are more willing to introduce them in practice.

As a part of operation "Cooperation" according to Article 56 and 57 of the EAFRD Regulation, creation and functioning of operational groups for innovations (EIP) will be supported, associating farmers (including groups of agricultural manufacturers and agricultural cooperatives), scientific units, entrepreneurs, forests holders, non-governmental organisations and advisory entities, which under their operations will together prepare new solutions to be used in practice.

Figure 8 and 9 feature the creation and financing of operational groups.

RDP 2014–2020 states that the level of assistance for operational groups under "Cooperation" is 100% of the amount of eligible costs in the case of general costs, i.e. related to current costs of group functioning, the feasibility study, preparing operational plan of the group, animation, promotion of the programme's results and the preparation of business plan. The level of assistance connected with running research, directly connected with the implementation of the operation's subject amounts to 90%.

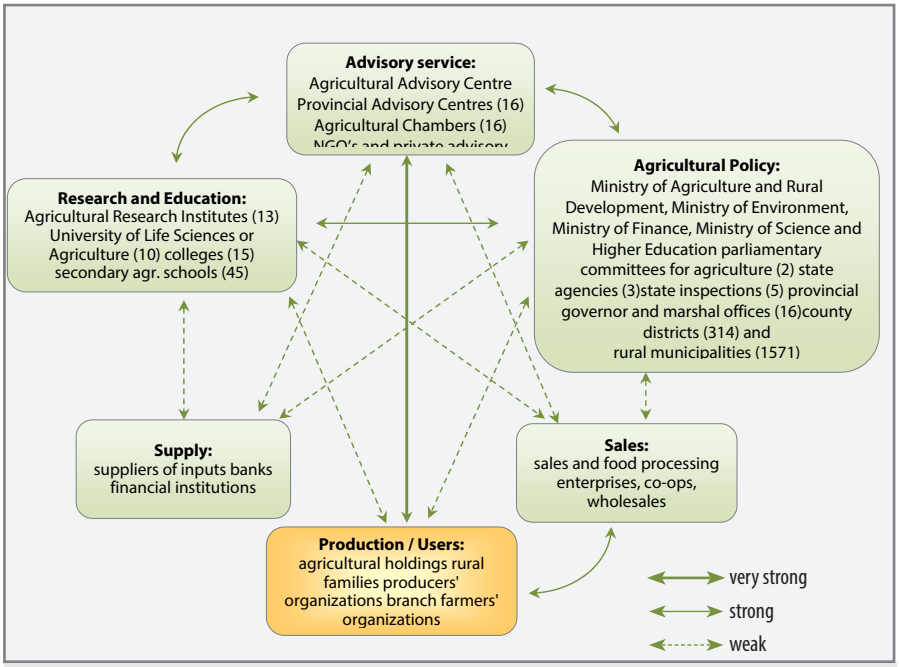

Figure 10 Stakeholders and their relations in the Agricultural Knowledge and Information System in Poland

Source: Kania, J.– Vinohradnik, K. – Tworzyk, A. 2014. AKIS and Advisory Services in Poland. Report for AKIS Inventory (WP-3) of the PRO AKIS project. Online resource: www.proakis.eu/publicationsandevents/pubs

General costs may constitute up to 20% of other eligible costs of the operation (maximum Euros 0.5 million), i.e. the costs of research and investment costs. Total maximum value of support amounts to Euros 2.5 million.

System of knowledge in the Polish agriculture

Figure 10 features the links between particular cells of the knowledge and information system. The degree of the link (as the average evaluation) is an expression of opinions of 49 participants of panel discussion. Very strong relations are present only among farmers and advisors from the ODRs, and strong relations among advisory and research and education and agricultural policy as well as among farmers and companies supplying them with means of agricultural production and companies of agricultural products purchase (Kania and others, 2014).

The results of panel discussions conducted with the directors of 16 ODRs concerning the assessment of their cooperation with other stakeholders of the system of agricultural knowledge in Poland is presented in Table 1.

We can note very good (11) and good (5) cooperation among the ODRs and agricultural research institutes subordinate to the Ministry of Agriculture and Rural Development. The cooperation is not as good as among advisory and agricultural universities that are subject to the Ministry of Science and Higher Education. Only four of the Agricultural Extension Centres declared very good cooperation, seven – good, four – poor and one of the ODRs did not cooperate with universities. Assessment of non-governmental organisations by the ODRs is quite good, but some of the ODRs treat these organisations as competitors. Not very good cooperation is present among the ODRs and suppliers and processors because they are partially perceived as competitors, employing own advisors. All the ODRs perceive new private consulting companies emerging on the market as competition.

Conclusion

Traditional, linear concepts of relation of science with agricultural practice in the form of the model of technology transfer or the model of social interaction are replaced by innovative network concepts in order to combine and better use the knowledge of all the participants of the networks and innovation partnerships being created. This is a new challenge both for units of agricultural extension, non-governmental organisations, research institutes and universities in creating and introducing into practice agricultural innovations and giving the opportunity for faster development and greater competitiveness of the European agriculture.

On the basis of the conducted analysis and the previously conducted research of the author (Kania, 2007; Kania et al., 2011; Kania et al., 2014a) we can risk the statement that in Poland there is so far no well-functioning Agricultural Knowledge System. Despite the presence of many institutions and organisations, the lack of mutual, practical relations makes it impossible for them to cooperate and operate as a system. It also results in the fact that the creation of agricultural knowledge often takes place separately from the needs and expectations of its recipients. For this reason, the effects of operation of different institutions and organisations, operating most often in dispersion or total isolation, involved in minor research are worse than could be expected, taking into account the size and the quality of the

Table 1 Collaboration and competing of agricultural advisory services (ODRs) with other stakeholders of AKIS in Poland (number of indications by 16 ODRs)

Organizations	Collaboration				Competition
	very good (close)	good	weak	lack	
Public research institutes	11	5	–	–	–
Agricultural universities	4	7	4	1	–
Government and self-government authority	9	6	1	–	–
Centres of knowledge, NGOs	2	11	2	1	1
Suppliers of agricultural inputs	1	7	4	4	6
Processors and traders	1	6	6	3	3
Private consulting companies	–	–	3	13	16

Source: own study

possessed intellectual potential. Very strong connections in the system are present only among advisers of ODRs and farmers.

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