

## **From Information Systems to Innovation Networks in Extension**

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**Abstract:** Recently, information development and transfer in agricultural sector are becoming more important especially in developing countries. Agricultural innovations are generally developed by research institutes and information about these technologies are transferred by public extension staff and private advisors to the farmers. In addition, information is also coordinated through agricultural support policies by the ministries of agriculture for development. Thus; farmers are needed to use right information in the system to make sound decision, evaluate the market opportunities better and direct their production systems according to the changing situations. In addition, all the stakeholders in the agriculture sector will be able to use the information sources effectively and acquire more outcomes through constructing a network to improve cooperation. The aim of this paper is discussed how and why the information for development in agriculture is evolved from information system approach into innovation system with network approach.

**Key words:** agricultural knowledge and information systems (AKIS), agricultural innovation system (AIS), communication networks, social network analysis (SNA)

### **Introduction**

Recently, information and knowledge have become leading production factors among others in the information age. Information increases the management skills of the entrepreneur. The productivity of other production factors can be developed through suitable, practical and confidential information and knowledge. Therefore; information transfers in the agriculture sector, which are provided by extension, research, education, library and other institutions; tried to be primarily coordinated by the ministries of agriculture and aimed to transfer this information especially to the farmers. Thus; individual producers in the system make sound decision, evaluate the market opportunities better and direct the production systems according to the changing situations. In addition, all the stakeholders in the agriculture sector will be able to use the information sources effectively and acquire more outcomes through constructing a network, which they can exchange their information for development (Manda, 2002; Ballantyne, 2009; Demiryürek, 2010/a,b; 2014).

The main aim of this paper is to present how information system in agriculture is evolved into innovation system. Thus, this paper presents significant concepts, models, approaches and methods related to agricultural information, knowledge and innovation systems and their analysis with social or communication networks.

### **Agricultural information, knowledge, technology and innovation transfer models**

#### ***Classical technology transfer model***

Transfer of Technology (TT) model had been widely used for the agricultural sector of several developing countries until 1980s (Figure 1). In TT model, the roles of actors in the system are defined as the development of information and technology for research, transfer for extension and adoption for farmers. Although this model was widely used all around the world; experiences showed that application of the model was partially adequate. This model is mostly suitable for the progressive farmers, who have rich resources and better conditions (Chambers, 1983; Röling, 1988). Since, the conditions of research institutes resemble mostly to these resource rich farmers (Chambers and Ghildyad, 1985). It is one way model, considers linear technology transfer, technological developments start in local research institutes or

international research centers and the farmers are expected to adopt that technology sooner or later. Therefore; understanding the concepts of knowledge and information systems is reflected poorly in the TT model (Röling, 1988).

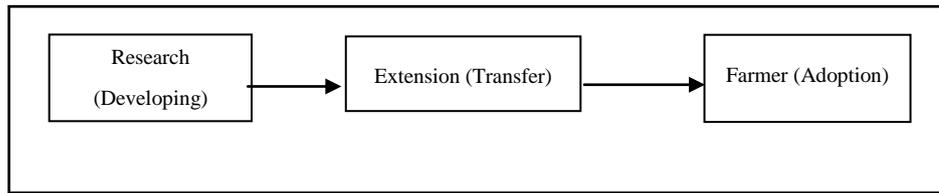


Figure 1. Technology Transfer Model (TT)

Leeuwis (2004) indicates that the error in the TT is not only related with the technology itself, but also related to the complex relations and active agreement process among multiple actors in the system (farmers, extension providers, researchers, the staff of other voluntary agencies).

### ***Agricultural Information and Knowledge Systems***

Röling (1988) also criticized the technology transfer model and developed Agricultural Information Systems (AIS). Röling (1988) defined the concept of Agricultural Information System (AIS) as: *“a system in which agricultural information is generated, transformed, consolidated, received and fed back in such a manner that these processes function synergetically to underpin knowledge utilisation by agricultural producers”*

This model can be applied to all farm systems to analyze the information systems, measure the achievement and understand how these systems work. In the concept of AIS, information processes such as production, transformation and utilization can be made by all the elements or actors in the system. For instance; research is not the only source of information and technology. Farmers, also, produce their own information, knowledge (especially at local level), and technology. Likewise; research can be the user of information and techniques of the farmers for developing and transforming the technology (Röling, 1990; Rolls et al., 1994). A simple model of AIS is given in Figure 2.

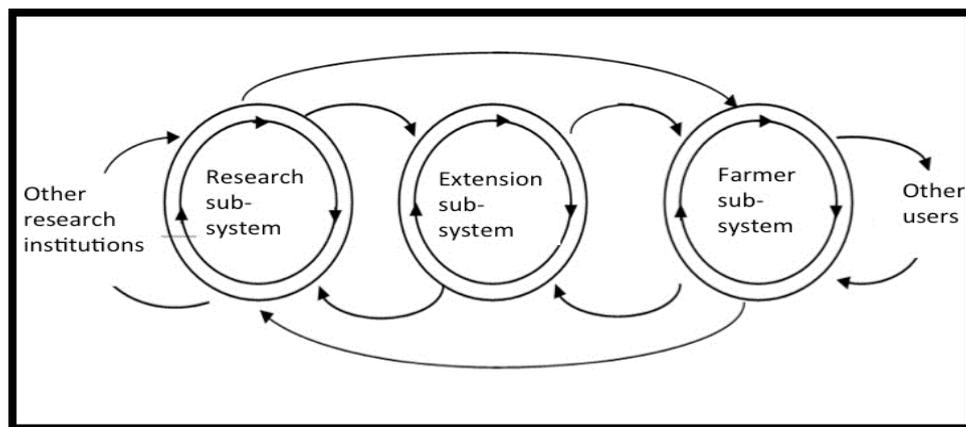


Figure 2. Agricultural Information Systems (AIS) Model (Röling, 1988)

AIS approach has applied several countries (Demiryürek, 2000; Garforth, 2001; Özçatalbaş et al., 2004; Opara, 2008; Aina, 2012).

Röling (1988), in the beginning, separates the concepts of information and knowledge and defines the concept of Agricultural Knowledge System, (AKS) as: *“a system of beliefs, cognition, models, theories, concepts and other products of the mind in which the (vicarious) experience of a person or group with respect to agricultural production is accumulated”* (Röling, 1988).

As different from the concept of AIS, AKS is rather a personal system and emphasizes the ability of personal perception and cognition. Rölting and Engel (1991/b) later integrated AIS and AKS and developed the concept of Agricultural Knowledge and Information System (AKIS). The definition of AKIS is given below:

*“The persons, networks and institutions, and the interfaces and the linkages between them, which engage in or manage the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilization of knowledge and information, and which potentially work synergistically to improve the goodness-of fit between knowledge and the environment, and the technology used in agriculture (Rölting and Engel, 1991/b)”.*

Later; the concept of AKIS became widely used by FAO and the World Bank. Different from the linear TT model, the farmers take place in the center of AKIS model; education subsystem is also added to the research and extension subsystems (Figure 3).

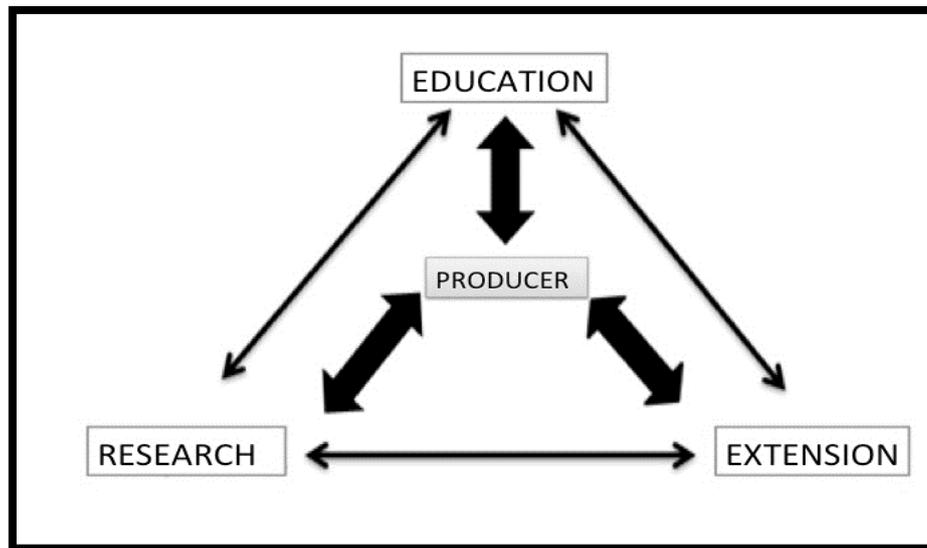


Figure 3. Agricultural Knowledge and Information Systems (AKIS), (Rivera et al., 2005)

Later; supporting systems (all the institutions providing income and credit to the farmers, farmer organizations, etc.) were also added to the components of farmer, research, education and extension which take part in the model and Agricultural Knowledge and Information Systems for Rural Development (AKIS/RD) model was developed. In the last form of this model; the four basic actors, politics, other executives, system inputs and outputs to the links between them were added. Therefore, Agricultural Knowledge and Innovation Systems-AKIS were developed (Figure 4). The starting point of this model was to understand and solve the limits of top to bottom technology transfer approach. Public administrators and politicians emphasize that the innovations in rural areas can be developed by different regions; the needs for developing local innovations are easier along with the responsibility of providing local education and knowledge. In two-sided, interactive and participatory Agricultural Knowledge and Innovation Systems model, participation of farmers and other actors have a critical importance, unlike the Agricultural Knowledge and Information Systems for Rural Development (AKIS/RD) model. If necessary communication and common decision making functions are not performed, effective communication between information sources and users will not be provided (Rivera et al., 2005; EU SCAR, 2012).

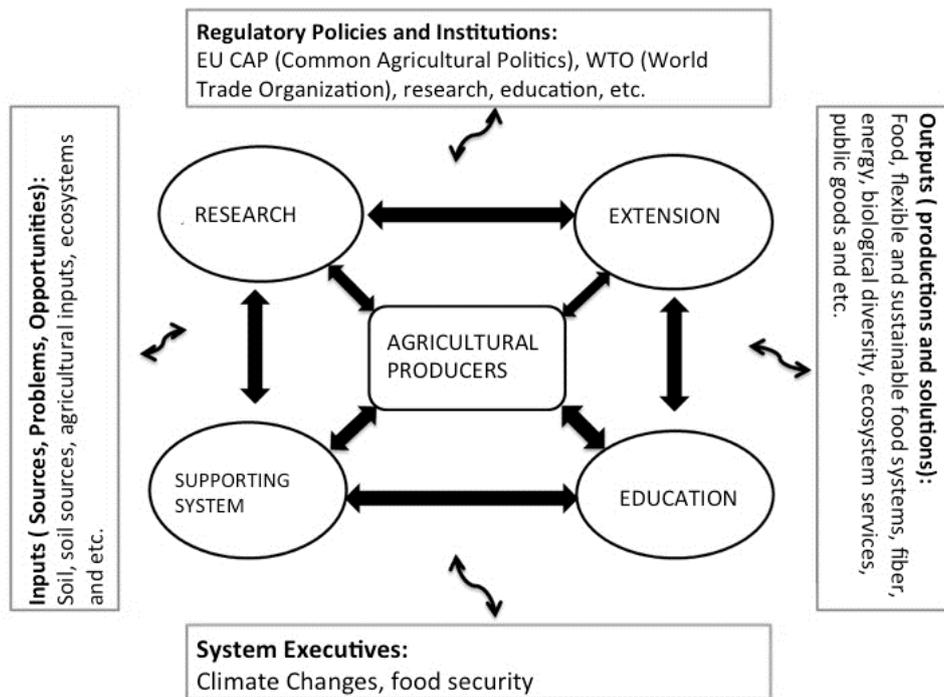


Figure 4. Agricultural Knowledge and Innovation Systems (Rivera et al., 2005).

### *Agricultural Innovation Systems*

An innovation system is a network consisting of various institutions, operations and people. Innovation systems focus on providing more economic and effective usage through bringing new products, new processes and new institution that forms together. If related institutions and supportive policies brought together, it will accelerate the adoption and diffusion of innovations (World Bank, 2006). In a simple definition, an innovation system can be defined as revealing more dynamic and multi-stakeholders collaborations through developing and employing technology and related processes to improve the welfare of the people.

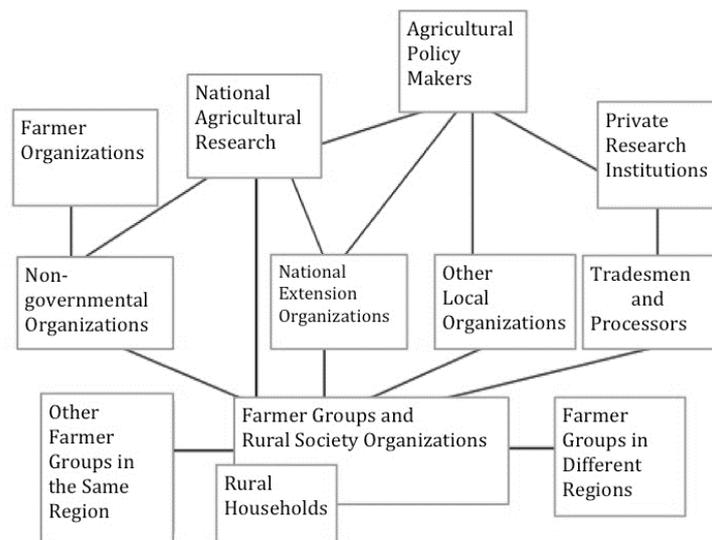


Figure 5. Actors and Linkages in the Agricultural Innovation Systems (Anandajayasekeram et al., 2008)

Agricultural Innovation Systems (AIS) approach brings different people and institutions in agricultural and rural areas together and emphasizes the importance of the relations between them (Figure 5). In addition, this approach involves all the other actors, relations and the links between them in the process from the production of the goods to market from the producer to the consumer. This approach centralizes the innovation instead of technology or research itself. AIS is a concept which extends perpetually and it requires flexibility to the applications of the innovation in different situations (Pound and Essegney, 2008).

The innovation systems approach also involves in researching processes related to the development, exchange and employing of information and knowledge in a focused society. In other words; Agricultural Innovation Systems (AIS) involve Agricultural Knowledge and Information System (AKIS) (Figure 6). In addition, it involves promoting the adoption of innovations as well as political supports and market regulations for providing the extension services to larger groups. AIS approach consists of radical change from the technology transfer approach which is conventional, linear and top to bottom towards an innovation systems approach (Spielman et al., 2011; Demiryürek, 2014).

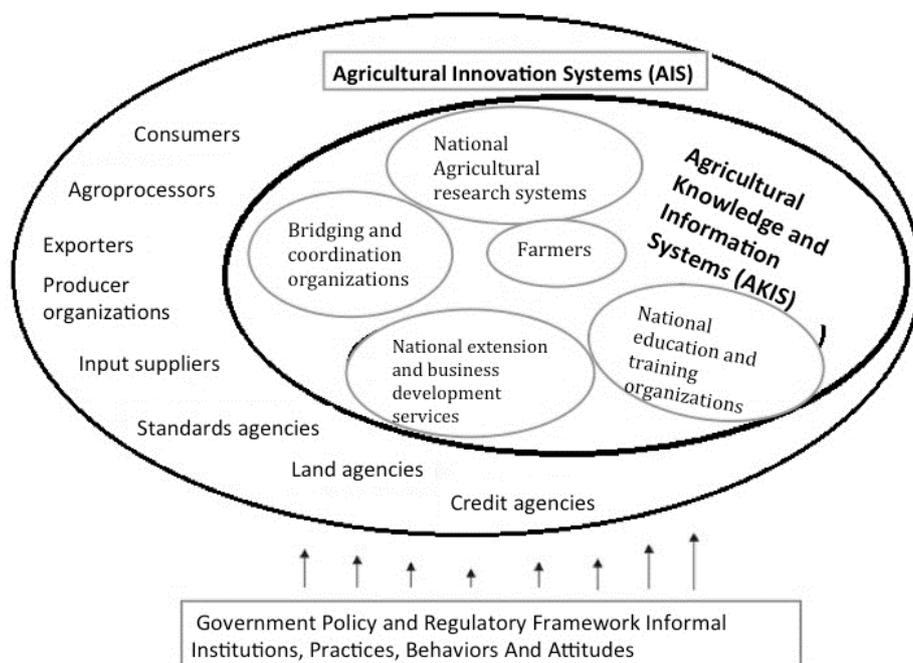


Figure 6. Agricultural Innovation Systems  
(World Bank, 2012: modified from Rivera et al. 2006).

Recently, Agricultural Innovation Systems approach is employed with the aim of analyzing the framework of technological, economical and institutional changes in agriculture. As seen in the Figure 6, with this approach; innovation is accepted as a conclusion of the processes of interactive learning between different heterogeneous groups such as farmers, input suppliers, agroprocessors, tradesmen, researchers, extensionists, civil servants and non- governmental organizations and constructing a network. In addition; this approach emphasizes that agricultural innovations are not only about recent technologies, but they also consist of developing alternative methods such as market, workforce, way of land ownership; distribution of agricultural supports (Leeuwis, 2004). This approach aims to determine how effective are the roles, responsibilities, actions and interaction of a wide range of actors in the process of developing innovation. Along with this, it tries to analyze how the market and politic factors affect this process (Spielman et al., 2011).

Presenting a social network consisting of relation and integration of individual and organizational actors involve part in the process of development and diffusion of innovation, determining the problems and indicating alternative solution methods are the most important features of innovation systems. One of the best ways of analysing Agricultural Innovation System is to use network theory and social network analysis (Demiryürek, 2008; Demiryürek, 2010; Demiryürek and Aydoğan, 2010).

### Social Network Analysis for Agricultural Innovation Systems

AIS, AKS, or AKIS approaches reveal how agricultural information and knowledge exchanged or in other words, communication is occurred and shared among the components of the system through system approach (Demiryürek, 2001). These approaches have a critical importance from the aspect of developing technology and transferring information about this technology (Rogers, 1995; Ramirez, 1997; Garforth, 2001; Leeuwis, 2004). In spite of this, adoption and diffusion of innovations theory (Rogers, 2003) employ communication network (Rogers and Kincaid, 1981) and social network analysis (de Nooy et al., 2005). In other words, communication networks are a kind of social networks and they are innovation networks in basic. Communication network approach reveals the information and innovation sharing between individuals and organization which are related with each other (Rogers and Kincaid, 1981; Demiryürek, 2010/a,b). However, this can be analyzed through Social Network Analysis (SNA) (Demiryürek, 2008; Demiryürek and Aydoğan, 2010). SNA reveals the form of communication in a society (in a social system) (Rogers and Kincaid, 1981; Valente, 2006). Rogers (2003) emphasizes the importance of information exchange network (communication) for agriculture and assesses that the diffusion of innovation can be analysed through the network in a social system.

Social Network Analysis (SNA) assumes that the relations between groups are important. SNA examines, analyzes and presents graphically through considering the way of interactions between units that makes the information transfer between units easier or hinders. In the network who are in relation with whom; who shares what knowledge with whom through using which means of communication. An example of a Social Network Analysis graph is given in Figure 7.

SNA, in terms of adoption of innovations; presents subsidiary ways to figure out how the actors interact, how information and sources exchange between actors and other units and how the roles of actors and relations are constructed (Demiryürek, 2008; Demiryürek and Aydoğan, 2010; Spielman et al., 2011).

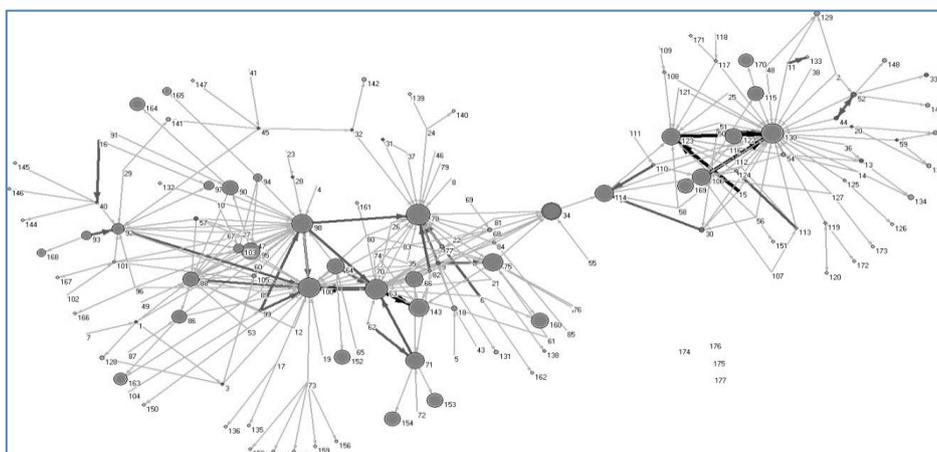


Figure 7. An example of a Social Network Analysis indicating the first and second knowledge sources of the producers (Aydoğan and Demiryürek, 2013).

## Conclusion

In this paper; concepts, models and approaches which are related to agricultural information, knowledge, innovation systems and agricultural communication networks are presented. Agricultural Knowledge and Information Systems (AKIS) is basically developed from the system theory and used for understanding the information and knowledge relations between individuals and organizations which take part in a social system. Analysing AKIS can determine the issues in a system and offer suggestions for developing a better one. In the approach of Agricultural Knowledge and Information Systems for Rural Development (AKIS/RD) which was developed by FAO and World Bank, it is aimed to make people living in rural areas more aware of and make better use of communication exchange system. Agricultural Innovation Systems (AIS) approach which was developed later was based on network theory. With Agricultural Innovation Systems (AIS) approach, it is aimed to present social network which is constructed by relations and interactions of all the actors taking part in the innovation development and extension process, determining the problems and offer alternative solution for these issues. Different from the other approaches, in Agricultural Innovation Systems (AIS) approach, especially market shapes and politic supports are examined in addition to agricultural production related to the process of innovation. One of the update and effective ways of analyzing Agricultural Innovation Systems (AIS) is to employ Social Network Analysis (SNA). The studies of analyzing agricultural information and innovation system along with social and communication networks have a very important function in determining policies for developing rural areas. Presenting offers for the solutions to the system problems and determining current social (communication) network among all the stakeholders contribute to the understanding and management of agricultural information and innovation systems.

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