Information systems and communication networks for agriculture and rural people

Informační systémy a komunikační sítě pro zemědělství a venkov

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Abstract: This review paper presents the concepts, theories and literature review that are relevant to information systems and communication networks for agriculture and rural people. The usefulness of information systems and communication networks is discussed in order to identify the system components, their networks, the understanding of how successfully they work and how to improve their performances. The definitions of terms used in this paper, such as information, system, information system, agricultural information systems and communication networks are first presented and discussed. The rationale of the system theory and information system approach and analysis method for agricultural information systems are described and discussed. In addition, the findings of related previous studies are reviewed and summarized. Finally, general conclusions about agricultural information systems are emphasized and implications for further research areas are presented.

Key words: system, information, information system, agricultural information system, communication networks

Abstrakt: Autor prezentuje koncepty, teorie a literární rešerši týkající se informačních systémů a komunikačních sítí pro zemědělství a venkov. Užitečnost informačních systémů a komunikačních sítí je zde diskutována za účelem identifikace systémových komponent, jejich sítí a pochopení toho, jak mohou úspěšně fungovat a jak lze jejich činnost zlepšit. Nejprve jsou prezentovány definice pojmů použitých v příspěvku, jako je informace, systém, informační systém, zemědělský informační systém a komunikační sítě. Poté jsou popsáné a komentované základy systémové teorie, přístup založený na informačních systémech a metody analýzy zemědělských informačních systémů. Je zde rovněž shrnut přehled předchozích studií týkajících se uvedené problematiky. Konečně příspěvek podtrhuje obecné závěry týkající se zemědělských informačních systémů a poznatky vyplývající z nich pro další výzkum.

Klíčová slova: systém, informace, informační systém, zemědělský informační systém, komunikační sítě

Agricultural information can be seen as an important factor which interacts with the other production factors such as land, labour, capital and managerial ability. The productivity of these other factors can arguably be improved by the relevant, reliable and useful information and knowledge. Hence, the information supply from extension, research, education and others has become managed by agricultural organizations, and especially disseminated to farmers so that they can make better decisions to take advantage of market opportunities and to manage continuous changes in their production systems. Therefore, there is a need to understand the functioning of the particular agricultural information systems in order to manage and improve them (Demiryürek et al. 2008).

However, there have been limited studies about the agricultural information systems and especially communication networks for farmers. Thus, there is a need for substantial information about these issues, including the mechanisms of the information systems, interactions between components in the system, and their activity. Specifically, the information requirements of farmers, the structure of the organizations involved in these activities are issues that need to be explored.

Thus, the present review study can be considered as a contribution to the understanding of the conceptual

framework and literature review about agricultural information systems and communication networks. The analysis methods and process explained, if found useful, will be available for analyzing and developing information systems for agriculture and rural people. They can also be used to develop suggestions to solve the common problems, to improve the policy programs, the extension and research activities, and to manage information on agriculture and rural people.

This review paper presents initially the conceptual frameworks for agricultural information system. In other words, the definitions of the terms used in this paper, such as information, system, information system; agricultural information system and communication networks are first presented. The rationale of the system theory and information system approach and analysis method for information systems are secondly described and discussed. Thirdly, the findings of the related previous studies are reviewed. Finally, the general conclusions about agricultural information systems are emphasized and implications for the further research areas are recommended.

CONCEPTUAL FRAMEWORK

The definitions of the terms used in this research, such as information, system, information system, agricultural information system and communication networks, are first presented and discussed. The rationale of the system theory and the agricultural information system approach is described.

Information is structured data within a context that gives it meaning (Checkland and Holwell 1998). Information can be processed, generated, transformed and shared (Röling 1988), through complex processes of coding and decoding, generally known as communication. The communication of information is a major concern for the agricultural extension services (Demiryürek 2000). A system is a group of interacting components, operating together for a common purpose (Spedding 1988). It is characterized in terms of its hierarchical structure, emergent properties, communication and control (Checkland 1981). The term subsystem is equivalent to system, but it is contained within a larger system. The system approach is a way of looking at an entity and dealing with problems in order to identify and improve the particular system. It can be applied to any subject (Spedding 1988). The system research has also shown a high potential for offering a conceptual framework to analyze, manage and improve the current system and to design a better one (Cavallo 1982). The models of social systems can be used as a tool for analyzing the information requirements of actors involved in a system (Checkland and Holwell 1998). Ciborra (2002: 5) defines information systems as: "… deal with the deployment of information technology in organizations, institutions, and society at large".

In the general system theory, an information system is accepted as a system, automated or manual, that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data which represent information. Processed information becomes knowledge when an individual knows (understands) and evaluates it. Thus, the knowledge system is more an individual basis and emphasizes the personal cognition (Demiryürek 2000). However, groups of people may share a common knowledge system such as an indigenous knowledge system (Brokensha et al. 1980).

Information systems are also social systems whose behaviour is heavily influenced by the goals, values and beliefs of the individuals and groups, as well as the performance of the technology (Angel and Smithson 1991). Wilson (2000: 49) clearly defines information behaviour as: "… the totality of human behaviour in relation to sources and channels of information, including both active and passive information seeking, and information use. Thus, it includes the face-to-face communication with others, as well as the passive reception of information as in, for example, watching the TV advertisements, without any intention to act on the information given".

Röling (1988: 33) defends the usefulness of the system approach to analyze agricultural information and defines an agricultural information system as "… a system, in which agricultural information is generated, transformed, consolidated, received and fed back … to underpin knowledge utilization by agricultural producers".

Accordingly, the concept of agricultural information system reflects the components in the system, the information related processes (generation, transformation, storage, retrieval, integration, diffusion and utilization), system mechanisms (interfaces and networks) and system operations (control and management). Research, extension and farmer can be seen as the major components (subsystems) of an agricultural information system. However, various actors and organizations can be found in a system. It can be applied to any specific farming systems in order to analyze how the information system works. This approach is also useful to define the possible defaults and to improve the coordination between components (i.e. information management) (Demiryürek 2000). In addition, the information exchange (communication) through networks among the system components

is critically important for the successful technology generation and information transfers (Rogers 1995; Ramirez 1997; Garforth 2001; Leeuwis 2004). A communication network consists of interconnected individuals who are linked by the patterned flows of information, and its analysis identifies the communication structure in the system (Rogers and Kincaid 1981). Rogers (1995) emphasizes that the exchange of information (communication) and its diffusion take place within a social system. Actors such as individuals, informal groups, organizations and subsystems are the members of the system and the structure of the social system and their actors or members' roles affect the diffusion process.

ANALYSIS METHODS FOR AGRICULTURAL INFORMATION SYSTEMS

Important questions arise to analyze the agricultural information system for farmers and their information sources. These questions are the sources of information, the content of information, the exchange (both receive and transfer) of information, the extent of the information contact, the degree of usefulness and the reason for not using it, the type of information needed and so on.

The information matrix can be used to analyze a specific agricultural information system. This matrix may include possible sources of information, their extent of contact, usefulness of information and other related subjects can be questioned and all respondents were asked to indicate their status related to these questions for each sources of information.

Limited numbers of studies have been discussed the methods for analyzing the agricultural information systems (Röling 1988; Engel 1995; Garforth and Usher 1996). Some studies (Jones et al. 1987; Rolls et al. 1994; Ramkumar 1995; Ortiz 1997; Demiryürek 2000; Garforth 2001; Boyacı 2006) had only used the frequency of information contact with various information sources in order to measure the information score. On the other hand, Rolls et al. (1999) and Rolls and Slavik (2003) had separately analyzed the extent of the contact and the degree of the information usefulness. Demiyürek et al. (2008) and (Demiryürek 2010) used the Total Information Score (TIS), which is a combined variable of the frequency of contact with information sources and their usefulness. Thus, the TIS reflect not only the quantity but also the quality of the information contact.

In order to define the concept of information contact, the respondents can be asked to specify each source of information and the frequency of contact in a specific year. In addition, they can be asked to rate the degree of usefulness for each information source. Instead of asking them to select whether these sources were good or bad, these ratings included multiple choices ranging from not useful to a little useful, somewhat useful and so on. Thus, a frequent contact without useful or relevant information can be eliminated. In addition, the frequency of contact and the degree of usefulness can be correlated to measure the agreement between these two variables. These methods of presenting the multiple choice questions, eliminating the irrelevant information contact and positive correlation may help to increase the validity of measurements. In addition, the respondents should be provided detailed information and explanations regarding how to rate the categories of usefulness.

Information scores for each component of the information systems can be calculated by multiplying the weight of the information contact with the degree of information usefulness. The TIS is formulated as

$$\text{TIS} = \text{number of contact} \times \text{usefulness of information}$$

The weights can be given to each component according to the extent of the information contact. A weight of 0 can be given for no contact, 1 for once a year, 2 for two times a year and so on. Similarly, the degree of usefulness of information sources can also be weighted. A weight of 0 can be given to not useful at all, 0.25 for a little useful, 0.50 for somewhat useful, 0.75 for useful and 1.00 for very useful. The scores can be calculated on the basis of the percentages of farmers reporting each level of usefulness for each source.

The degree of information contact can also be categorized into different groups according to the information scores of each information source. These items can be classified as weak, moderate and strong degrees of the information contact. This classification can be based on the average and standard deviation of the information scores.

These scores can also be compared between different kinds of producers and/or production systems. In addition, the scores can be correlated or compared with the socio-economic characteristics of different groups of farmers and farms. Comparing the socio-economic characteristics of farmers and their farms is essential to develop the appropriate methods to transfer information and analyze the information systems, since the information systems are the construct of the personal characteristics of the farmers (Rolls et al. 1999), and together with the production practices they are major influences on their information management (Naidoo and Rolls 2000).

LITERATURE REVIEW ABOUT PREVIOUS STUDIES

Although the research into the information system and its probable impact on agricultural holdings are vital for the sound policy recommendation, few studies have addressed the relationship between farms and their information sources. Some of the important researches related to and providing support for the current review study are summarized here.

One of the early studies conducted by Rolls et al. (1994) analyzed the information system for smallholder farmers in Malaysia and used the concept of the agricultural information system different to the research, extension and farmer model. There was a considerable information exchange among the actors in the system and the farmers in particular were active in disseminating the innovative information and technology. On the other hand, Garforth and Usher (1996) reviewed various models of information system processes. Systems models allowed the researchers to move away from the linear conceptions of information and technology development and dealt more effectively with the diversity of information sources available to the potential users.

Rolls et al. (1999) analyzed the information systems in Czech agriculture. The information system appeared to be the construct of the personal characteristics of the farmers. The farmers appeared to regard information as a social good to be exchanged and discussed within social networks. The printed materials, agricultural shows, and demonstrations were strong sources of agricultural information, and the consultants also gained recognition as valued components of the information system. Rolls and Slavik (2003) also investigated the change in the information systems in Czech agriculture. The actual sources of information were changed, though about half remained the same. The printed media remained the most important, social sources decreased in importance, and professional sources such as consultants, research and university sources increased. The horizontal transfer of information between similar farms remained very important. The researchers suggested that new information sources were needed relate to agricultural information and predicted that computerised databases will be increasingly used in the future.

Demiryürek (2000, 2010) also used the agricultural information system and communication network theories to analyze the current information systems their communication networks used by organic and non-organic hazelnut producers and found that the information systems for the two groups of farmers were largely separate. Hoang et al. (2006) explores how social networks function as assets for people and households in the rural areas of developing countries and influence the access to information and the benefits from research and development. They presented a case study of such networks in a village of Northern Vietnam and provided evidence of the need for the efficient delivery of extension services and research and development interventions at the micro level.

In contrast to the farmers networks analyzed at the micro level by Hoang et al. (2006), Morone et al. (2006) researched information diffusion and social networks in the organic food sector in the province of Foggia, Italy. They found that the organic sector was becoming more complex, presents a challenge for organic farms and firms to overcome these changes. They also studied the role of institutions in diffusing information to the producers and identified the crucial information needs and gaps.

Demiryürek et al. (2008) also analyzed the agricultural information systems and communication networks for the members and non-members of the Dairy Cattle Breeders' Association (DCBA) in the Samsun province of Turkey. The research results revealed that the Association memberships mainly function in a system that aims at keeping more European purebred cows and providing financial incentives, rather than developing a modern dairy sector as an alternative to the traditional dairy farming systems.

Recently, there have been some studies on the use of the digital information systems and technologies in the agricultural and food sectors. Šilerová and Lang (2006) discussed the usage of the information systems and the expansion of the portals in the rural sector. The development of the information systems and its implementation with the portal solutions enable a web access to the information and the effective management and administration (Šilerová and Kučírková 2008). Similarly, Kučera and Látečková (2006) pointed out the importance of information systems concerning the solutions by the computer software and the expertise systems in agriculture and food sectors. These systems help to make decision and contribute to the information management. Mistr (2007) also stressed that the future of the information systems will have to be designed as user friendly computer programs and portals in the agricultural information systems. Dařena (2007) applied the information systems theory to marketing and established marketing information systems to support and manage marketing activities.

In summary, the literature review showed there are few studies about the models of (Röling 1988; Röling and Engel 1991; Rolls et al. 1994; Röling and Jiggins

1998) and analysis methods for (Röling 1988; Engel 1995; Garforth and Usher 1996; Ramirez 1997) agricultural information systems. Although there are some farm-level studies on information systems (Ramkumar 1995; Ortiz 1997; Demiryürek 2000; Jordan et al. 2003; Boyacı 2006; Demiryürek et al. 2008), studies on social networks (Rogers and Kincaid 1981; Hoang et al. 2006; Morone et al. 2006; Demiryürek 2008) for farmers are very limited. Apart form the application of information systems to agricultural sectors, information systems can be applied to agricultural business, marketing and food sectors with the appropriate software and web portals to support decision making and information management (Kučera and Látečková 2006; Šilerová and Lang 2006; Dařena 2007; Šilerová and Kučírková 2008).

CONCLUSION AND IMPLICATIONS

This review paper presented the concepts, theories and literature review that are relevant to information systems and communication networks for agriculture and rural people. The analysis methods for information systems were also discussed. The findings of the related previous studies were reviewed and summarized. Now, the general conclusion about this review and implications for further research on agricultural information systems and communication networks can be presented.

The agricultural information system reflects the interfaces and networks in a system, and contributes to the control and management of the system. In addition, the analysis of the agricultural information systems may provide the identification of the basic components and networks of the system. It can be applied to any specific farming systems in order to analyze how the information system works. This approach is also useful to define the possible defaults and to improve the information management. In addition, the information exchange (communication) through networks among the system components is critically important for the successful technology generation and information transfers.

The agricultural information system theory helps us to understand the situation as a whole (i.e. to provide a holistic approach) and to identify the strengths and weaknesses of the system studied. In contrast to the usual holistic approaches to the analysis of agricultural information system, the more individual and cognitive processes of producers (i.e. knowledge system), could be an interesting subject for the further research. In addition, the analysis of the complex social structures in rural settings can be made with a more dynamic social (communication) network analysis at the micro level.

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