Managing agriculture knowledge: role of information and communication technology

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The emergence of Information and Communication Technologies (ICT) in the last decade has opened new avenues in knowledge management that could play important roles in meeting the prevailing challenges related to sharing, exchanging and disseminating knowledge and technologies. ICT allows capitalizing to a greater extent on the wealth of information and knowledge available for Agriculture Knowledge, Science and Technology (AKST). The ultimate objectives of AKST activities are to come up with results that can advance research more in certain areas, and engender technologies that AKST stakeholders can use to increase production, conserve the environment, etc. The following paragraphs will discuss the knowledge management challenges, explain how ICT could play a role in addressing them, and highlight an example of an institution in the Egyptian Agriculture Research Center whose main function is to conduct applied research in ICT in Agriculture.

**Challenges related to sharing, exchanging and disseminating knowledge and technologies**

The first challenge is the poor mechanisms and infrastructure for sharing and exchanging agriculture knowledge generated from research at national and regional levels. Many research activities are repeated due to the lack of such mechanisms and infrastructure at the national level. Researchers can find research papers published in international journals and conferences more easily than finding research papers published nationally in local journals, conferences, theses and technical reports. The second challenge is the inefficient mechanisms and infrastructure for transferring technologies produced as the result of research to growers either directly or through intermediaries (extension subsystem). Knowledge and technologies fostering agricultural production and environment conservation are examples. Although many extension documents are produced by national agriculture research and extension systems to inform growers about the latest recommendations concerning different agricultural practices, these documents are not disseminated, updated or managed to respond to the needs of extension workers, advisers and farmers. This is also true for technical reports, books and research papers related to production. The third challenge is keeping the indigenous knowledge as a heritage for new generations. It is available through experienced growers and specialists in different commodities. These inherited agricultural practices are rarely documented, but they embody a wealth of knowledge that researchers need to examine thoroughly. The forth challenge is easily accessing and availing economic and social knowledge to different stakeholders at operational, management and decision-making levels, so that those responsible will be able to make appropriate decisions regarding the profit making of certain technologies and their effect on resource-poor farmers.

**ICT Role in Agriculture Knowledge Management**

Knowledge sharing, exchanging and dissemination are elements in a broader theme which is knowledge management. The central purpose of knowledge management is to transform information and intellectual assets into enduring value (Metcalf, 2005). The basic idea is to strengthen, improve and propel the organization by using the wealth of information and knowledge that the organization and its members collectively possess (Milton, 2003). It has been pointed out that a large part of knowledge is not explicit but tacit (Schreiber et al., 1999). This is true for knowledge in agriculture where a lot of good practices are transferred without being well documented in books, papers or extension documents. To manage the knowledge properly, ICT is needed. In effect, there are many information technologies that can be used for knowledge management. The following paragraphs describe these technologies and emphasize their roles in agriculture knowledge management.
Content *management system in its wider sense including data bases and multimedia,* is the core technology of information and knowledge management. This technology can be used in different applications:

- Building a national agriculture research information system (NARIS) needs to include research outcomes, projects, institutions and researchers in every country, and a regional research information system that works as a portal for all the NARIS. An example NARIS has been developed at the agriculture research center in Egypt (ARC, 2007).
- Developing an information system of indigenous agricultural practices can enable researchers to examine this knowledge and decide on its usefulness for sustainable development. Such a system will also keep this knowledge for future generations before it disappears as a result of advanced technologies.
- Developing an information system recording matured technologies that on a trial basis have proven successful and success stories that have achieved economic growth will strengthen the interaction between inventors and innovators. This will lead to an innovation-driven economic growth paradigm.
- Storing and retrieving images, videotapes and audiotapes related to different agricultural activities.

**Geographic information systems** (GIS) are needed to store databases about natural resources with a graphical user interface that enables users to access these data easily using geographical maps.

**Decision support system** techniques are needed in many applications:

- Simulating and modeling methods can be used to build computer systems that can model and simulate the effect of different agricultural production policies on the economy and the environment to help top management make decisions.
- Using expert systems technology to improve crop management and track its effect on conserving natural resources is elaborated in Rafea (1999). This technology may also be appropriate for keeping indigenous knowledge (Rafea, 1995, 1998, 2000). Expediting the expert systems development by generating agriculture specific tools to overcome the well known problem of knowledge acquisition is addresses in Abdul-Hadi et. al. (2006). Enhancing the explanation capabilities of expert systems developed for agriculture was also investigated by Said et. al. (2009)

Modern ICT—Internet and Web technology—is needed to make these systems available regionally and globally. Accessing the Internet will bring a wealth of information to all agriculture stakeholders in rural and urban areas and will help in overcoming the digital divide. As most farmers in CWANA have no hands-on experience or access to digital networks, leaders of national agricultural research and extension systems should be encouraged to consider the ICT option. Training farmers and extension workers, including women, in ICT will help them access a lot of useful information if each country tries to develop contents in the language people are using.

Text Mining is being currently investigated in two applications in the Central Laboratory for Agricultural Expert System (CLAES) in Egypt:

- Developing an Intelligent focused search engine which aims at extracting the appropriate textual segments responding to a user query. In order to do that there is a need to develop ontology or extend an existing ontology. In agriculture there is the AGROVOC developed by FAO but we found many local concepts instances that need to be part of this ontology. Some work was done by Hazman et. al. (2009) to learn ontology from textual documents. It is also needed to segment document into passages that are semantically coherent. El-Shayeb et. al. (2006, 2007) worked on segmenting html and textual documents. Annotating these segments semantically using the ontology concepts is found necessarily (El-Beltagy et. al., 2007)
• Mining growers’ problems database which is part of the Virtual Extension and Research Communication Network (VERCON) (CLAES 2002; FAO, 2003) to discover the best practices from the solutions provided by the human experts and find out whether there are any discrepancies in their recommendations.

**Using ICT in Agriculture in Egypt**

In 1987, officials at the Egyptian Ministry of Agriculture and land reclamation recognized expert systems as an appropriate technology for speeding development in the agricultural sector. To realize this technology, in 1989, the ministry initiated the Expert Systems for Improved Crop Management Project (ESICM) in conjunction with the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Development Programme (UNDP). The project began in mid-1989 and the Central Laboratory for Agricultural Expert Systems (CLAES) joined the Agricultural Research Center (ARC) in 1991. Through the development, implementation and evaluation of knowledge-based decision support systems, CLAES is helping farmers throughout Egypt optimize the use of resources and maximize food production. A dozen expert systems have been developed for horticulture and field crop management. In 2000, the Virtual Extension and Research Communication Network (VERCON) project was funded by the FAO Technical Cooperation Program (TCP) to develop a Web-based information system to strengthen the link between research and extension (CLAES, 2002; FAO, 2003). This network has been extended to include other stakeholders, and other services through a project funded by Italian Debt Swap Program and executed by FAO in collaboration with CLAES (CLAES, 2008). Several expert systems have been made available on this network in addition to other modules. In collaboration with ICARDA, CLAES has developed three regional expert systems for wheat (CLAES, 2006c), faba (CLAES, 2006d) and barley (ICARDA, 2006). CLAES also developed the National Agricultural Research Management Information System (NARIMS) through a project funded by FAO/TCP. This system has five modules: Institutes Information System, Researchers Information Systems, Projects Information Systems, Publication Information System, and National Research Program Information System (CLAES, 2007).

**References**


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