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Role of ICT in Knowledge Management

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It is inevitable to know about the significant role of ICT in Knowledge Management. Knowledge management comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of insight and experiences comprising knowledge, either embodied in individuals or embedded in organizational process or practice. The concerted efforts on Knowledge Management typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, integration and continuous improvement of the organization. KM efforts overlap with organizational learning and may be distinguished from that by a greater focus on the management of knowledge as a strategic asset and a focus on encouraging the sharing of knowledge. KM efforts can help individuals and groups to share valuable organizational insights, to reduce redundant work, to avoid reinventing the wheel per se, to reduce training time for new employees, to retain intellectual capital as employees' turnover in an organization, and to adapt to changing environments and markets.

Actually different frameworks for distinguishing between knowledge exist. One proposed framework for categorizing the dimensions of knowledge distinguishes between tacit knowledge and explicit knowledge. Tacit knowledge represents internalized knowledge that an individual may not be consciously aware of, such as how he or she accomplishes particular tasks. At the opposite end of the spectrum, explicit knowledge represents knowledge that the individual holds consciously in mental focus, in a form that can easily be communicated to others. Early research suggested that a successful KM effort needs to convert internalized tacit knowledge into explicit knowledge in order to share it, but the same effort must also permit individuals to internalize and make personally meaningful any codified. Knowledge retrieves from the KM effort. Subsequent research into KM suggested that a distinction between tacit knowledge and explicit knowledge represented an oversimplification and that the notion of explicit knowledge is self-

contradictory. Specifically, for knowledge to be made explicit, it must be translated into information (i.e., symbols outside of our heads). Later on, Ikujiro Nonaka proposed a model (SECI for Socialization, Externalization, Combination, Initialization) which considers a spiraling knowledge process interaction between explicit knowledge and tacit knowledge. In this model knowledge follows a cycle in which implicit knowledge is 'extracted' to become explicit knowledge and explicit knowledge is re-internalized into implicit knowledge. More recently, together with George von Krogh, Nonaka returned to his earlier work in an attempt to move the debate about knowledge conversion forward.

Similarly, a second proposed framework for categorizing the dimensions of knowledge distinguishes between embedded knowledge of a system outside of a human individual (e.g. an information system may have knowledge embedded into its design) and embodied knowledge representing, a learned capabilities of a human body's nervous and endocrine systems. A third proposed framework for categorizing the dimensions of knowledge distinguishes between the exploratory creation of 'new knowledge' (i.e. innovation) vs. the transfer or exploitation of 'established knowledge' within a group, organization, or community. Collaborative environments such as communities of practice or the use of social computing tools can be used for both knowledge creation and transfer.

Context independence
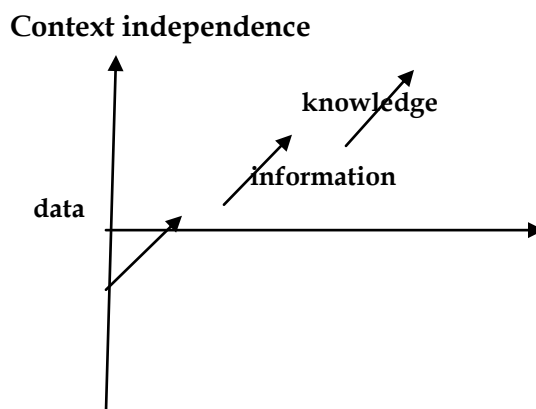
It is to be noted that, before attempting to address the question of knowledge management, it is probably appropriate to develop some perspective regarding this stuff called knowledge, which there seems to be such a desire to manage, really is. Consider this observation made by Neil Fleming as a basis for thought relating to the following.

- A collection of data is not information.
- A collection of information is not knowledge.
- A collection of knowledge is not wisdom.
- A collection of wisdom is not truth..

We have to make out the idea that information, knowledge and wisdom are more than simply collections. Rather, the whole represents more than the sum of its parts and has a synergy of its own. We begin with data, which is just a meaningless point in space and time, without reference to either space or time. It is like an event out of context a letter out of context, a word out of context. The key concept here is "out of context." And, since it is out of context, it is without a meaningful "relation to anything else". When we encounter a piece

of data, if it gets our attention at all, our first action is usually to attempt to find a way to attribute meaning to it. We do this by associating it with other things. If we see the number 6, we can immediately associate it with cardinal numbers and relate it to being greater than 5 and less than 7, whether this was implied by this particular instance or not. If we see a single word, such as "time' there is a tendency to immediately form associations with, previous contexts within which we have found "time" to be meaningful. This might be "being on time," "a stitch in time saves 'nine," 'time never stops," etc. The implication here is that when there is no context, there is little or no meaning. So, we create context but more often than not, that context is somewhat akin to conjecture, yet it fabricates meaning.

Still it is to be remembered that, as a collection of data is not information, as Neil indicated, it implies that a collection of data for which there is no relation between the pieces of data is not information. The pieces of data may represent information, yet whether or not it is information which depends on the understanding of the one perceiving the data. We would also tend to say that it depends on the knowledge of the interpreter, but we are, probably getting ahead of ourselves, since we haven't defined knowledge. What we will say at this point is that the extent of our understanding of the collection of data is dependent on the associations we are able to discern within the collection. And, the associations I am able to discern are dependent on all the associations we have ever been able to realize in the past. Information is quite simply an understanding of the relationships between pieces of data, or between pieces of data and other information.

As we understood, while information entails an understanding of the relations between data, it generally does not provide a foundation for why the data is what it is, nor an indication as to how the data is likely to change over time. Information has a tendency to be relatively static in time and linear in nature. Information is a relationship between data and quite simply, is what it is with great dependence on context for its meaning and with little implication for the future. Beyond relation there is pattern, where pattern is more than simply a relation of relations. Pattern embodies both a consistency and completeness of relationships which to an extent, creates its own context. Pattern also serves as an Archetype with both an implied repeatability and predictability.

Another point is that, when a pattern relation exists amidst the data and information, the pattern has the potential to represent knowledge. It only becomes knowledge, however, when one is able to realize and understand the patterns and their implications. The patterns representing knowledge have a tendency to be more self-contextualizing. That is, the Pattern tends, to a great extent, to create its own context rather than being context dependent to the same extent that information is. A pattern which represents knowledge also provides, when the pattern is understood, a high level of reliability or predictability as to how the pattern will evolve over time, for patterns are seldom static. Patterns which represent knowledge have completeness to them that information simply does not contain.

Similarly wisdom arises when one understands the foundational principles responsible for the patterns representing knowledge being what they are: And wisdom, even more so than knowledge, tends to create its own context. I have a preference for referring to these foundational principles as eternal truths, yet I find people have a tendency to be somewhat uncomfortable with this labeling. These foundational principles are universal and completely context independent. Of course, the last statement is sort of

redundant word game, for if the principle was context dependent then it couldn't be universally true. So, in summary the following associations can reasonably be made:

- Information relates to description, definition, or perspective (what, who when, where).
- Knowledge comprises strategy, practice, method, or approach (how).
- Wisdom embodies principle, insight, moral, or archetype (why).

The Value of Knowledge Management

To speak in an organizational context, data represents facts or values of result and relation between data and other relations have the capacity to represent information. Pattern of relations of data and information and other patterns have the capacity to represent knowledge. For the representation to be of any utility it must be understood. Yet what is the real value of information and knowledge, and what does it mean to manage it? In this example what needs to be managed to create- value is the data that defines past result; the data and information associated with the organization, it's market, its customer, and competition, and the patterns which relate all these item to enable a reliable level of predictability of the future. Knowledge Management is referred to be the capture, retention and reuse of the foundation understanding of how all these pieces fit together and how to convey them meaningfully to some other person.

Actually the value of Knowledge Management relates directly to the effectiveness with which the managed knowledge enables the members of the organization to deal with today's situations and effectively envision and create their future. Without on-demand access to managed knowledge, every situation is addressed based on what the individual or group brings to the situation with them. With on-demand access to managed knowledge, every situation is addressed with the sum total of everything anyone in the organization has ever learned about a situation of a similar nature. The question arising here is which approach would you receive would make a more effective organization?

In brief, Knowledge Management (KM) comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizations as processes or practices. More recently, other fields have started contributing to KM research; these include information and media, computer science, public health, and public policy. Many large companies and non-profit organizations have resources dedicated to internal KM efforts, often as a part of their business strategy, information technology, or human resource management departments. Several consulting companies also exist that provide strategy and advice regarding KM to these organizations. Knowledge management efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, integration and continuous improvement of the organization. KM efforts overlap with organizational learning, and may be distinguished from that by a greater focus on the management of knowledge as a strategic asset and a focus on encouraging the sharing of knowledge. It is seen as an enabler of organizational learning and a more concrete mechanism than the previous abstract research.

What is it?

The knowledge element primarily focuses on information that can easily be recorded in documents, such as

(1) Written technical documents and specifications
(2) Engineering drawings and calculations
(3) Specifications for design, fabrication, and installation of process equipment
(4) Other written documents such as material safety data sheets (MSDSs).

Throughout this chapter, the term process knowledge will be used to refer to this collection of information. The knowledge element involves work activities associated with compiling, cataloging, and making available a specific set of data that is normally recorded in paper or electronic format. However, knowledge implies understanding, not simply compiling data. In that respect, the competency element complements the knowledge element in that it helps ensure that users can properly interpret and understand the information that is collected as part of this element. The knowledge and competency elements are closely linked in other ways as well. The competency element involves work activities that

(1) Promote personal and organizational learning and

(2) Help ensure that the organization retains critical information in its collective memory.

It is to be noted that, technology manuals and other written documents produced as part of the competency element are often stored and distributed via the knowledge element's management system. A key distinguishing feature of information developed as part of the knowledge element is that it generally has a high degree of structure, which applies to all processes. In addition, the primary objective of the knowledge element is to maintain accurate, complete, and understandable information that can be accessed on demand. Conversely, a technology manual compiled as part of the competency element often includes historical information; it is also less structured and is much more likely to include sections that are "under development" based on ongoing projects within the company's research and technology functions. Information collected and maintained by the knowledge element tends to answer questions starting with "What," for example, "What is the area and overall heat transfer coefficient for this heat exchanger?" whereas the competency element helps process knowledge users answer questions starting with "Why", such as, "Why is this heat exchanger ten times larger than it needs to be for routine service?" The knowledge element includes work activities to ensure that the information is

(1) Kept current and accurate

(2) Stored in a manner that facilitates retrieval

(3) Accessible to employees who need it to perform their process safety-related duties.

Why is it Important?

Risk understanding depends on accurate process knowledge. Thus, this element underpins the entire concept of risk-based process safety management; the RBPS methodology cannot be efficiently applied without an understanding of risk. Process knowledge also supports other RBPS elements. For example, the procedures, training, asset integrity, management of change, and incidents elements all draw on information that is collected and maintained as part of the knowledge element. (http://www.aiche.org)

Agriculture Knowledge Management: Role of Information and Communication Technology

It is a pertinent fact to observe that 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.

Basically 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 sub-system). 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 works, advisers and farmers. This is also-true for technical reports, books and research papers related to production. Thus 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.

Statistics proves that almost 60–70% of more than a billion people depend on agriculture in India. One of the major constraints affecting agricultural productivity in the country is the problem of availability of timely and relevant agricultural information to the farmers. The existing ways of transfer of agri-technologies do not reach the majority of the small and marginal farmers across the country due to a large gap in the ratio of extension workers and farmers. From late twentieth century, there have been rapid advances in technology and improvisation in the ways the information is stored, processed and communicated. For faster transmission of improved farm technologies, information and communication technology (ICT) can play a significant role. The past decade has been characterized by changing patterns of rural market; hence, the role of ICT has been increased from providing the networks to setting up of the origin of modernised technical programmes in the rural vicinity. Various innovative ICT applications by both government and private initiatives have been developed for better communication and rapidly changing demand of the consumers in rural areas. This article reviews the ICT initiatives of Gyandoot, Warana Wired, e-Choupal, mKrishi project, etc., to comprehend their role in technology dissemination to the agricultural community and examining the changes in agricultural productivity due to their usage.

It is found that the ICT initiatives still require significant improvements in supporting infrastructure and capacity building amongst farmers to enable them to use the information they access effectively. As ICT access continues to increase among farming communities and information services continue to adapt and flourish, the scope exists for a much better rural productivity impact in the future (Source: http://www.indianjournals.com). Information and Communication Technology (ICT) was raised as a new feature in the Sudan agricultural sectors in the contemporary time. Usage of ICT to disseminate and share information in Sudanese rural areas is one of the important components of agricultural development in the country. The challenges are to make ICT available to rural people and to build efficient national agricultural information system to increase access to information at the national level, in addition to connect rural people to global information networks. The main objective of this study was to determine the use of Information and Communication Technologies (ICT) by extensionists in the Gezira State, Sudan. Field survey was used to collect data from 50 extensionists in the Gezira State. The collected data were statistically analyzed and interpreted using percentage and frequency distribution. The results showed that there are many constraints facing the use of ICT by the extensionists in the State include lack of personal computers, high cost of ICTs in general, lack of technical knowhow, lack of good infrastructure, lack of internet centres of Ministry of Agriculture in the villages, lack of internet cafes in the villages. It can be concluded that the majority of extensionists in the State still depend on the use of mobile phone and the traditional ICT (radio and TV) only in their contacts with farmers and the constraints which are facing them in their use of ICT in the State led to this unfavorable situation. Thus, more efforts should be exerted to the solution of ICT illiteracy in the country, agricultural extension organizations in the State should develop their programmes which are concerned with the use of new ICT by extensionists in their various agricultural extension work. The constraints which are facing the extensionists in their use of ICT in the State should be solved by all parties concerned with usage of ICTs. (Ahmed M. Abdul Rahman, Use of Information and Communication Technologies (ICTS) by Agricultural Extensionists in the

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In a broader theme, Knowledge sharing, exchanging and dissemination are elements which comprise knowledge management. The central purpose of knowledge is to transform information and intellectual assets into enduring value. (Metcalfe, 2005). The basic idea is to straighten, 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:

In reality, 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. 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 achieved economic growth will strengthen the interaction between Inventors and innovators. This will lead to an innovation-driven economic growth paradigm. Storing and retrieving image 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 viz., 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 decision. Using expert systems technology improves crop management and tracks its effect on conserving nature. Expediting the expert systems development by generating agriculture specific tools to overcome the well known problem of knowledge is inevitable.

Mining growers' problems database which is part of the Virtual Extension and Research Communication Network (VERCON) to discover the best practices from the solutions provided by the human experts and find out whether there are any discrepancies in their recommendations. Modem 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 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 county tries to develop facilitate other rural services.

ICTs in Agricultural Knowledge Management

The toughest and mammoth task of driving the knowledge sharing process in agriculture necessitates extension to adapt to ICT mediated Knowledge Management (KM). Of late, organisations in agriculture realised the importance of managing the knowledge (implicit & explicit; internal & external) for effective targeting and dissemination. The new face of 'digital divide' is "digital information/knowledge divide". Knowledge management can play a pivotal role in enhancing agricultural productivity by enabling appropriate knowledge and information to reach knowledge intermediaries and farmers in a timely manner. Agricultural Knowledge Management strategies are built on huge agricultural content (Data- information-Knowledge). In most developing countries, agricultural institutions have not moved to a level where new and consistent information services to farmers and other stakeholders are offered based on quality and contexts. For adopting KM strategies in extension, we need to pay more attention to (1) codifying and sharing tacit (i.e. implicit) knowledge, (2) creating new knowledge and (3) having everyone in the organization involved in the process. Only then the organisation can be viewed as a living organism capable of creating continuous innovation in a self-organising manner."

The Directorate of Knowledge Management in Agriculture is committed to promote ICT driven technology and information dissemination system for quick, effectual and cost-effective delivery of messages to all the stakeholders in agriculture. Keeping pace with the current knowledge diffusion trends, Directorate is delivering and showcasing ICAR technologies, policies and other activities through print, electronic and web mode. Directorate is the nodal center for design, maintenance and updating of ICAR website along with facilitation of network connectivity across ICAR institutes and KVKs. Besides, Directorate provides public relation and publicity support to the council and its constituents across the country.

Thrust Areas

- Dissemination and sharing of agricultural knowledge and information through value added information products in print, electronic and web mode.
- Development of e-resources on agricultural knowledge and information for global exposure.
- Facilitation for strengthening e-connectivity among ICAR institutes State Agricultural Universities and KVKs.
- Capacity building for agricultural knowledge management and communication.

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 to 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).

## Agricultural Knowledge and Information System (AKIS)

The present study provides a preliminary response to the question: How can developing countries encourage the various systems, organizations and producers concerned with agricultural research, education and extension, and operating in the public or private sector to behave as one system with regard to the agricultural development component of rural development? In other words: What do developing countries need to establish and maintain an Agricultural Knowledge and Information System (AKIS) that targets agriculture, broadly conceived as crops, livestock, fisheries and forestry as a main component of rural development (RD)? Cases studies on the present-status and direction of AKIS/RD in ten countries are reviewed and compared with a view to providing preliminary answers to this question: Following the publication of a joint FAO/ World Bank document on AKIS/RD Strategic vision and guiding principles (2000) the Food and Agriculture Organization of the United Nations (FAO) commissioned case studies of AKIS/RD in various countries. The case studies were based on almost identical terms of reference, and set out to discover the extent to which an AKIS/RD vision and principles were being perused. The case studies were carried out over the period 2000 to 2003 by national consultant in Cameroon; Chile, Cuba, Egypt, Lithuania, Malaysia, Morocco, Pakistan, Trinidad and Tobago and Uganda. In addition to gathering data on interventions

that have contributed to the development of AKIS/RD in these ten countries, FAO also held national workshop AKIS/RD in four of them - Malaysia, Pakistan, Trinidad and Tobago, and Uganda. The Organization also plans to hold an international technical meeting on AKIS/RD at same later date. The ten country case studies on AKIS/RD cover various regions South Asia, North Africa, East Africa, West Africa, the America and Eastern Europe. They also fall into three distinct economic categories as defined by the World Bank's World development indicators for 2003: low-income (Cameroon, Pakistan and Uganda); lower middle income (Cuba, Egypt and Morocco) and upper middle-income (Chile, Lithuania, Malaysia, and Trinidad and Tobago). While each consultant received almost the same Terms of Reference, every case study is distinct for the reasons already mentioned and also because the status of AKIS/RD and the issues that comfort them differ from case to case,

The present article highlights unique or innovative steps undertaken in the countries to strengthen AKIS/RD, assesses the commonalities among the countries, compare the strength and weaknesses that emerge in each case study, and reviews the lesson learned as underscored by the consultants. On the basis of this synthesis of experiences from the ten countries, the study puts forward a preliminary set of narrative guidelines for advancing AKIS/RD.

What is an AKIS/RD in brief?

An AKIS/RD is a system that links rural people and institutions to promote mutual learning and generate, share and utilize agriculture-related technology, knowledge and information. The system integrates farmers, agricultural educators, researchers and extensionists to harness knowledge and information from various sources for better farming and improved livelihoods. This integration is suggested by the "knowledge triangle" displayed here.
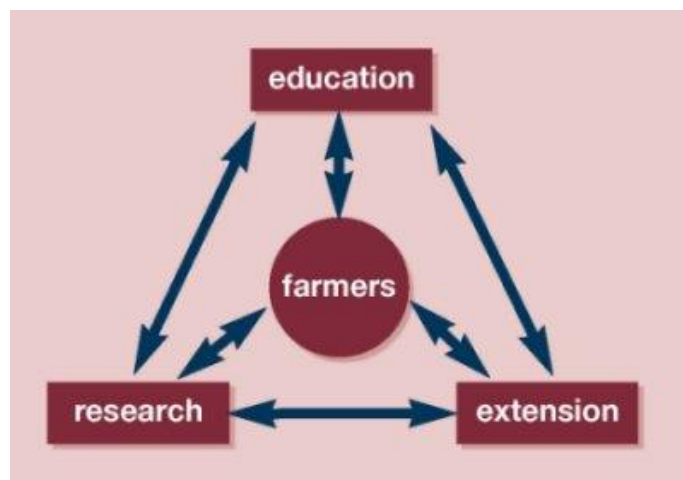
The AKIS/RD vision document is intended as a vehicle for sharing ideas and principles with the various stakeholders addressing the causes, and for seeking solutions for rural poverty. Operational guidelines, inspired by this shared vision and consistent with the principles outlined here are under preparation by the World Bank and FAO. (Source:

http://www.fao.org) Agricultural and Rural Development is increasingly dependent on the efficient functioning of agricultural knowledge systems. More specifically, it depends on how the production, transmission and implementation of scientific knowledge and available technologies are managed. It is thus crucial to improve the interface between the production of knowledge and its adoption in food businesses related to agriculture, fisheries and rural areas. To that end, two initiatives developed in Spain, which are based on the use of new information technologies, can be identified as agricultural knowledge system (AKS) successes: The knowledge platform for rural areas and fisheries (MARM) and The Rural Cat of the Generalitat of Catalunya (Source: http://www.oecd-ilibrary.org)

ORGANIZAION OF THE STUDY

The study was organized into six main sections, beginning with the present introduction. The second section discusses the ten country case studies in terms of their different stages of AKIS and AKIS/RD development. Its Table 2 identifies 24 criteria that are utilized to rank each country's commitment to the advancement of AKIS/RD and/or the actions that countries have taken to promote this. These 24 criteria are organized into five main categories:
(1) Policy environment
(2) Institutional structure for supporting innovation
(3) Conditions for expressing demand for innovation
(4) Partnerships and networks;
(5) Financing systems for innovation.

The original nine principles outlined' in the FAO/World Bank document are handled under these few main categories. The third section examines the strengths and weakness relevant to AKlS/RD in the ten country case studies in line with the five main categories and the 24 criteria. It then goes on to the highlight innovative features in the various country studies, and these again are organized according to the main categories. The fourth section presents lessons learned regarding AKlS/RD development each of the countries as expressed by the national consultants. The fifth section provides guidelines for strengthening AKIS/RD, drawing on the case studies and their recommendations; this discussion is also based on the five main categories. Section 6 conclusions, "from idea into action", summarizes the study and its implications for advancing AKlS/RD in developing countries. Following the conclusion, references list the country case studies and the books and articles utilized in developing the present study. Finally, the annexes include, among other things, condensed profiles of the ten countries whose case studies.

THE AKIS/RD VISION AND PRINCIPLES

Speaking the true perspective, agriculture's challenge is to achieve the integral goal of being productive, profitable and sustainable and nonpolluting. The AKlS/RD challenges this happen. The catalyst for the present review was the joint FAO/World Bank (2000) publication on developing strategic vision and guiding principles for AKlS/RD. This brief document (20 pages) outlines a vision, strategies and guiding principles for designing AKlS/RD systems. The main purpose underlying the document is to promote rural development by reducing poverty, promoting gains in agricultural productivity, and

ensuring food security and environmental sustainability in developing countries. It sets out the following four main operational purposes.

(1) To set forth a shared vision for an integrated approach to agricultural education, research and extension that would respond to the technology, knowledge information of rural people, helping them to reach informed decisions on the better management of their farms, households and communities.

(2) To facilitate dialogue with decision-makers in both government and development organizations, ensuring that proposals for investment in AKIS/RD are well founded and receive due consideration.

(3) To provide the staff of FAO and the World Bank and their Counterparts in client countries with a common set of principles to guide their work in agricultural education, research and extension.

(4) To ensure synergies from complementary investments in education, research and extension resulting in more effective and efficient systems.

The systematic and strategic vision underlying the FAO/World Bank document is focused on rural people, especially farmers, pastoralists and those who eke out a living from forestry or fishing in the present study, these people are referred to generally as "agricultural producers". Although some current trends emphasize off-farm and other income sources (AgREN E-Discussion 2004), most rural people depend directly or indirectly on agriculture for their livelihoods. The FAO/World Bank document proposes a strategic vision for an AKIS/RD that

(1) accurately identifies the constraints and opportunities facing male and female farmer" and their wider communities, through engaging scientific methods to generate appropriate economic, social and technological responses

(2) helps rural people gather the social skills and technologies needed to Augment their productivity manage their ,natural resources sustainably, raise their incomes, collaborate effectively with one another in addressing their common problems and become effectively involved with other stakeholders in determining the process of further technology generation and adoption

(3) enables governments to carry out activities for the public good, for example, ensuring food safety, conserving the environment reducing poverty and promoting education, research and extension, whether from Public or private suppliers

(4) provides education and continuous training and mutual learning opportunities for educators, researchers, extensionists and farmers alike, allowing them to work together effectively.

The FAO/world Bank document lays-out nine guiding principles, which are intended to assist in achieving the AKIS/RD objectives of poverty reduction, agricultural productivity gains, food security and environmental sustainability. These guiding principles are

- Economic efficiency
- Careful matching between the comparative advantage of organizations and the functions they perform
- Clear repartition of costs
- Careful assessment and optimal mixing of funding and delivery mechanisms
- Pluralistic and participatory approaches

- Effective linkages among, farmers, educators, researchers, extensionists and other AKIS/RD stakeholders.
- Building human and social resources
- Sound monitoring evaluation (M&E)

Then the question is how best to realize this vision and apply these principles. To respond to this question, the present article reviews the commonalities; lessons learned and recommendations put forward in the case studies.lt also adds 15 other factors that appear essential to the successful development of AKIS/RD. On the basis of this examination, a number of normative guidelines are put forward for consideration.

To put in a nut shell, AKIS/RD is an   Agricultural Knowledge   and Information System   for Rural Development which links people and institutions to promote mutual learning and generate, share and utilize agriculture-related technology, knowledge and information. The system   integrates farmers, agricultural educators, researchers and extensionists to harness knowledge and information from various sources for better farming and improved livelihoods. This integration is suggested by the "knowledge triangle" displayed below. Rural people, especially farmers, are at the heart of the knowledge triangle. Education, research and extension are services public or private designed to respond to their needs for knowledge with which to improve their productivity, incomes and welfare and manage the natural resources on which they depend in a sustainable way. A shared responsiveness to rural people and an orientation towards their goals   ensures synergies in the activities of agricultural educators, researchers and extensionists. Farmers and other rural people are partners within the knowledge system, not simply recipients.

FROM AKIS AGENCIES TO AN AKIS TO AKS/RD
AKIS and AKIS/RD

Strictly speaking, a successful institutional system is more than the sum of its parts (Rivera and Schram, 1987; Roling, 1989). A set of institutions becomes a "system" when its individual components are interlinked or articulated and the separate institutions are connected so that they communicate and cooperate in action to share their human, physical and financial resources in order to achieve one or more common goals.

AKlS agencies

In most countries, modern agricultural development efforts started with the establishment of research, extension and agricultural education institutions. These were frequently stand alone research institutes, universities and extension services that, in theory; maintained linkages with each other to promote the development and transfer of new technologies to farmers. However, linkages among the institutions were, often weak, while those with the clients (eg: Farmers) were even weaker. Overall performance was far below expectations which led to a need to move beyond independent AKIS agencies in order to promote rural innovation more efficiently and effectively.

The AKIS "knowledge triangle"

It is a truth that, the endeavors to articulate the set of knowledge systems or subsystems of agricultural research, extension and education into an AKIS are not new indeed the literature is replete with brooks and articles on linkages and linking of the three major agricultural knowledge systems. (ln this article, these systems will henceforth, be referred to as "sub-systems", as they are considered parts of a larger AKIS framework aimed at improving agriculture within a general concern for rural development.) In addition to the initiatives taken by FAO and the World Bank, the organization of Economic Co-operation and Development (OECD) held a major conference in 2006, which brought together directors and representatives of agriculture research, agriculture advisory service and education in agriculture to discuss what is termed Agricultural knowledge system (AKS) in September 2003, World Bank held a workshop for Eastern, European and Central Asian countries in Tbilsi, Georgia to discuss the overall reform of AKIS, while focusing on the sustainability of competitive Grant programs (World Bank, 2003).

The original diagram to illustrate AKIS/RD (Figure 1) simply highlights the three basic institutional components of AKIS/RD and the central purpose of the system to serve farmers, whom in this document are more aptly referred to as "agricultural producers". The illustration does not point to other entities involved, such as government, the private sector civic society, support system markets etc. nor does this simplified diagram recognize the importance of AKIS/RD to users and beneficiaries other than rural producers. In addition, it implicitly emphasizes the importance of agriculture for rural development, eventhough it is widely recognized that agricultural innovation is important in itself and in its support for other pathways, other pathways also contribute to-the development of the rural sector. (de Janvry and Sadoulet, 2001; Berdegue and Escobar, 2003; FAO,2003).

Figure 1 was originally intended to suggest that agricultural information systems development link institutions with people (the end-users of knowledge who are agricultural producers) to promote learning AKIS/RD strategic vision guiding principles (FAO/World Bank, 2000) proposes generating, sharing and utilizing agriculture related technology, knowledge and information in a strategically aligned system. Such a system integrates farmers, agricultural educators, researchers and extensionists to harness knowledge and information from various sources for better farming and improved livelihoods, as well as regional and national stability and growth. This integration is needed now more than ever, challenges of competing in a globalized economy and building competitive advantages aimed at global agricultural market opportunities:
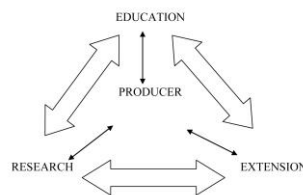

**Figure 1: Agricultural Knowledge and information system for Rural Develop**

AKIS/RD development

Other ideal models of AKIS/RD that have been put forward are more inclusive of the contextual and environmental systems involved. One such model, which was used by the consultant for the Pakistan case study, illustrates four major subsystems and their idealized information follows

(1) the knowledge creation subsystem
(2) the knowledge diffusion subsystem
(3) the knowledge utilization subsystem
(4) the agricultural support subsystem involve in credit, input and market functions.

Given inclusiveness of the AKIS/RD vision, if both public and private entities to operate within the four subsystems, the Pakistan model, (adapted to place agricultural Producers at its center) offer a more comprehensive model that includes agricultural support systems such as credit institutions, supplies and markets (Figure 2).

Figure 2 : An idealized AKIS/RD model
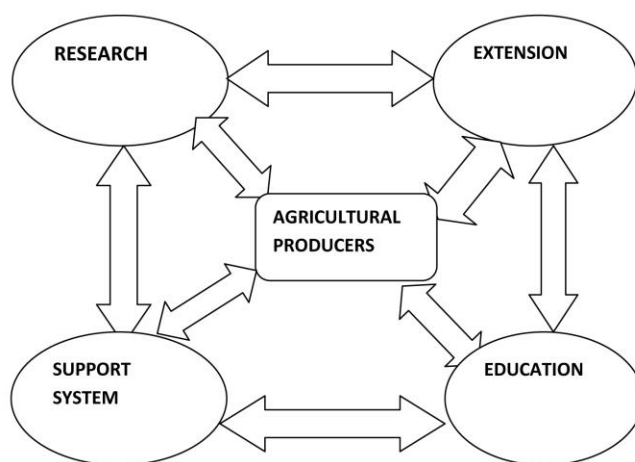
The Pakistan model might be further shaped to include relevant non-system components, such as government policy institutional commitment, communication systems other than those assisting extension and other relevant physical and human resources, as shown in Figure 3. This model, which illustrates the various components surrounding and influencing an AKIS/RD, is a more comprehensive rendering of the idealized AKIS/RD model, bringing together the various main actions with an impact on AKIS/RD and the specific subsystems that comprise the system. Although the addition of these components (policy, physical and human resources communications and institutional commitment) may render the model slightly messy, Figure-3 nonetheless suggests the numerous elements in AKIS/RD. ln fact, it could be made messier in that the policy, physical and human resources, communications and instructional elements should be connected to each of the four main sets of institutions research, extension, education and support

systems which themselves should include both public and private sector entities. In reality Figure 3, would more likely look like a web of crisscrossing connections.

Rural development

Rural development includes, but is broader than, agriculture and its development indeed, non-agricultural activities such as micro-enterprise development are priorities within the rural development strategies of international agencies, such as the lnter-American Development Bank (Echeverria, 1998). However, agriculture remains central to rural development. Most rural populations are engaged in some form of agricultural-development and although agricultural pursuits may not comprise the majority of all endeavours undertaken by rural people, they represent a plurality among the income-generating activities pursued by rural populations.
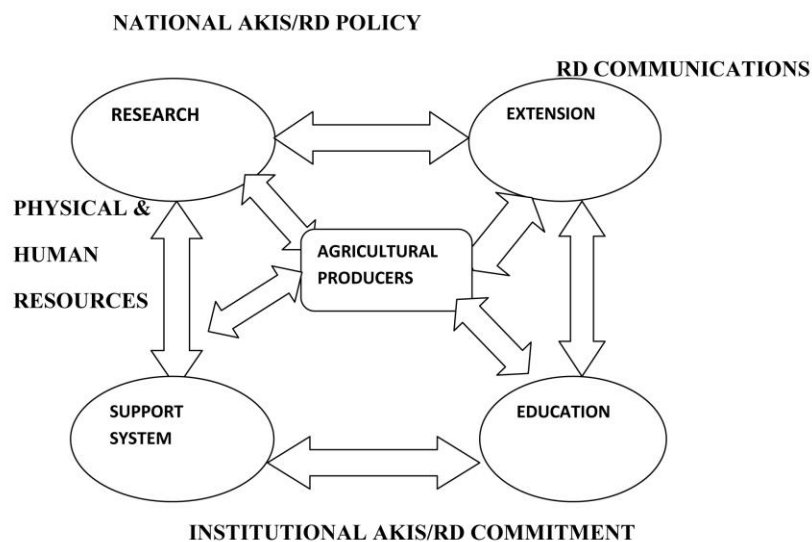

Figure 3 : A comprehensive AKIS/RD model

INSTITUTIONAL AKIS/RD COMMITMENT

International publications suggest that productivity gains in agriculture are essential for reducing poverty (World Bank, 2002). Agriculture is the main source of income for large numbers of people and provides the basic food subsistence needs for the majority of the population in these countries as well as being a main source of income' for governments that exploit food and fiber products (FAO, 1990). In the Malaysia case study, as with other upper middle-income developing countries, the- agriculture sector is currently regarded as a strategic sector. For many low-income countries, agriculture is and will remain for the foreseeable future the main sector producing exportable goods. Agriculture will also remain crucial for trade in many middle and high income countries (Brown, 1994) some two

thirds of the people in sub-Saharan Africa depend on agriculture for their livelihoods (Eicher, 2004)
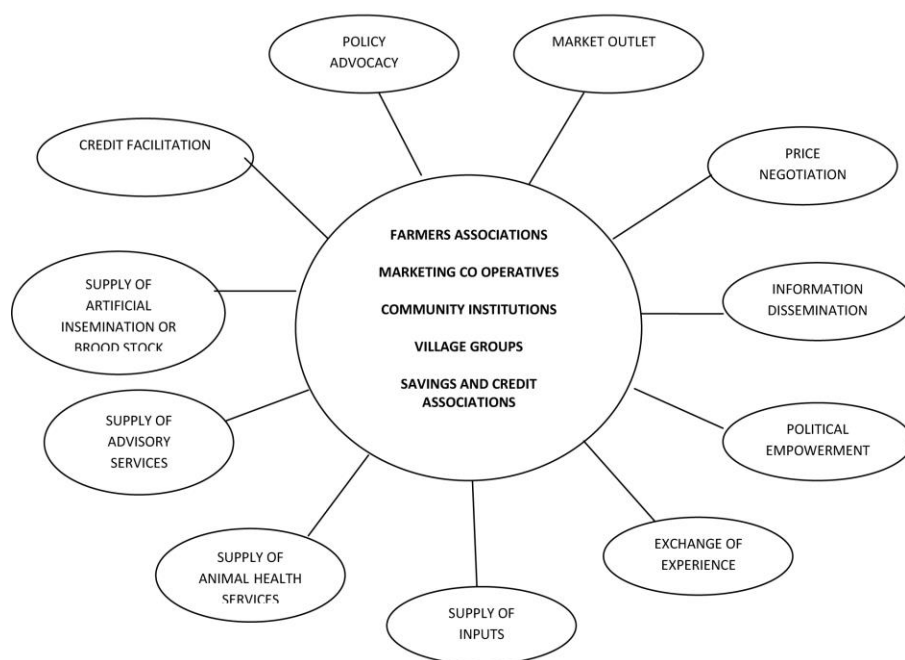

Figure 4: the multifaceted advantages of producer and community organization

In order to advance agricultural development governments with the assistance of international organizations are beginning to promote decentralized programmes, including subsidiary approaches that provide communities and rural producers organizations with the potentials to develop their own programmes for local development (Mercoiret et al., 2001). The World Bank promotes projects that empower rural people via community driven development (CDD), which encourages communities to move towards self-determination. These GDD projects assist communities to formulate proposals that are then reviewed and, if accepted funded.

In Denmark, experience confirms that small-scale producers can gain tremendously from organizing and working together to identify their needs and consolidate their demands. Producer organizations that are owned and controlled by the producers themselves have the potential to empower farmers and facilitate the delivery of services that respond to their needs and fulfill the required standards of quality. Figure 4 shows a sample of the multifaceted advantages that producer organizations and community institutions can offer the members. In some cases, governments have initiated efforts to establish nationality integrated and multispectral extension networks to combat food insecurity. These incipient national system networks include public and private for-profit and not-for-profit organizations, as well as international project aimed at food security goals. Some governments have created partnerships with other sectors of society, including multi-sectoral providers of extension and information services, in order to foster the conditions to

end hunger. These governments expect a food securing strategy to increase domestic food security and, eventually to facilitate inter and intraregional trade in food items. They understand that, when organized, poor farmers (i.e agricultural producers who are underprivileged) can produce beyond their own needs and enter the export market.

As we learned the glimpses of Knowledge Management Systems, now let's see the Content Management Systems in brief. Common website problem we often encounter are the following:

- No updating – static websites are difficult to update.

- No search function – users can not search your site to find content they are looking for.

- Limited Features– user login, forums, mailing lists features require custom code to implement and expensive to implement.

Content Management System (CMS)

A content management system is software that keeps track of every piece of content on your Web site, much like your local public library keeps track of books and stores them. Content can be simple text, photos, music, video, documents, or just about anything you can think of. A major advantage of using a CMS is that it requires almost no technical skill or knowledge to manage. Since the CMS manages all your content, you don't have to.

List of CMS

- Joomla
- Drupal
- Wordpress
- E-Z Publish

Open-source software is software whose source code is published and made available to the public, enabling anyone to copy, modify and redistribute the source code without paying royalties or fees. Open source code can evolve through community cooperation. These communities are composed of individual programmers as well as very large companies. Many of these individuals' programmers who start an open source project usually end up as large companies with open source programs. Examples of open-source software products are 7-Zip file archiver, Eclipse, OpenOffice.org, Joomla.

What is Joomla?

Joomla is an award-winning content management system (CMS), which enables you to build Web sites and powerful online applications. Many aspects, including its ease-of-use and extensibility, have made Joomla the most popular Web site software available. Best of all, Joomla is an open source solution that is freely available to everyone. Joomla! website brings together three elements

- Your content, which is mainly stored in a database.

- Your template, which controls the design and presentation of your content (such as fonts, colours and layout).
- Joomla! which is the software that bring the content and the template together to produce webpages.

Features of Joomla

- User Management
- Media Manager
- Language Manager
- Banner Management
- Contact Management
- Polls
- Search
- Syndication and Newsfeed Management
- Menu Manager
- Template Management
- Integrated Help System
- Powerful Extensibility
- Content Management
- Web Links Management

What joomla can do ?

- Corporate Web sites or portals
- Corporate intranets
- Online magazines, newspapers, and publications
- E-commerce and online reservations
- Government applications
- Small business Web sites
- Community-based portals
- Personal or family homepages
- School and church Web sites
- Non-profit and organizational Web sites

What is Joomla made up of?
- Components
- Modules
- Plugins
- Templates
- Core Libraries

Advnatages of Joomla
- Free and open source
- Full fledged CMS
- More powerful and robust than wordpress
- Admin out of the box, much more than just articles
- SEO Friendly
- Huge set of extensions

Disadvantages of Joomla
- Bigger learning curve
- Wordpress is better for simpler sites
- May need a developer for some of the changes

Joomla Useful Links:
- http://extensions.joomla.org
- http://developer.joomla.org
- http://docs.joomla.org
- http://api.joomla.org

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