FACTORS AFFECTING THE DEVELOPMENT OF KNOWLEDGE MANAGEMENT METHODS AS AN AID TO DECISION MAKING IN AN INDUSTRY UNDERGOING RAPID CHANGE

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Abstract

In the current climate of rapid change, organizations need to respond rapidly to external forces. The pressure to react quickly to customer demands and to take environmental changes into account has become a feature of today's organizational reality. Knowledge management has been deployed as a tool to aid in decision-making by knowledge intensive organizations. It has also been used to ensure that corporate knowledge assets are maintained in an era of frequent, fast and often discontinuous change. Numerous definitions of knowledge management have been proposed based on different perspectives of knowledge. These different perspectives have resulted in the development of a wide range of knowledge management strategies. Choosing a strategy that is appropriate to an organization is difficult, but the success of the knowledge management initiative may depend to a great extent on the suitability of the approach for that particular organization.

This paper uses the example of knowledge intensive rural organizations in Australia to explore the suitability of knowledge management as a resource to assist client decision-making during a period of rapid change. Knowledge management is a means whereby organizations can safeguard the value of their existing knowledge bases. It can also be used as a strategy for successful organizational change and to enhance the organization's ability to adapt to new objectives and processes.

The Dairy Research and Development Corporation (DRDC) is a knowledge organization providing funding for rural research and extension services in Australia. In recent times government priorities with relation to service delivery within the Australian dairy industry have been revised resulting in a rapid change in research goals and objectives. The main focus for research has changed from one centered mainly on farmer concerns to one that includes the whole supply chain of rural production and environmental factors.

This research illustrates that in times of rapid change existing knowledge management strategies may hinder rather than support an organization's ability to adapt to new requirements. The traditional methods of knowledge management may need revision as the context in which existing knowledge is used and new knowledge is created undergoes rapid and discontinuous change.

Although knowledge management has developed from a need to manage organizational change successfully, it appears that some knowledge management strategies may be better suited to organizations undergoing rapid change than others. The authors suggest that existing knowledge management strategies may need to be revised to allow organizations to take full advantage of existing knowledge bases. Most importantly an approach that reflects the way in which employees and clients use and create knowledge is essential to ensure the organization's continued success. The failure to reevaluate existing strategies as part of organizational change management may explain the limited success of knowledge management within some knowledge intensive organizations.

1. Introduction

The pressure to respond quickly to customer demands and to take environmental changes into account has become a feature of today's organizational reality. While much of the literature focuses on the fast pace required by e-business to keep up with changing demands and to respond to outside pressures, all types of organizations are affected by this trend. Fast decision making and sound business models continue to be a requirement for all organizations (Murphy 2001). Organizational change has for some time preoccupied managers and is extensively discussed in organizational literature (Robey 1986, Leavitt, Bahrami 1988). A volatile environment, increased competition and particularly information technology (IT) are accepted as the main catalysts and enablers for organizational change is regarded as inevitable and vital for organizational survival (Eason 1988). However, the rate of change and adaptation that is necessary has increased dramatically. Concepts such as the learning organization (Senge 1990, Huber 1990) and knowledge management (Malhotra 1997) have been developed in an attempt to help organizations deal with the effects of change.

Knowledge management has been extensively adopted by knowledge intensive organizations (Kamara *et al* 2002) to ensure the ongoing value of knowledge assets in an era of frequent, fast and often discontinuous change. However, not all knowledge management initiatives have been successful. Organizations find it difficult to choose among the various strategies and tools that are available and to identify one that is appropriate within a particular organizational context. In

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addition the complex issues associate with knowledge and its management such as knowledge acquisition and staff attitudes towards sharing are still problematic. Moreover, the faster pace of change and increasing demands to respond to environmental factors have created a situation where keeping knowledge bases up-to-date is becoming more difficult. This paper explores the factors affecting the development of various knowledge management strategies for knowledge intensive organizations within the Australian agricultural industry. Their effectiveness as a basis for decision making in order to increase profitability and sustainability in the current climate of rapid, discontinuous change is investigated. The research is based on a review of knowledge management initiatives and technologies employed within the industry.

The paper starts with an overview of different perspectives on knowledge, knowledge management and various knowledge management strategies and technologies for decision making. The effects of rapid, discontinuous organizational changes on existing knowledge bases and the suitability of specific strategies for its management within the knowledge intensive support organizations of the Australian dairy industry are investigated. The implications of rapid change and a turbulent environment on knowledge management are explored. The paper concludes by suggesting that not only are some knowledge management strategies better suited to for this purpose than others, but that in a climate of accelerating change the strategies themselves need constant reevaluation. The authors propose that a people-centered approach may be more appropriate than strategies that focus primarily on technology.

2. Perspectives on Knowledge and Knowledge Management

"Understanding knowledge is the first step to managing it effectively" (Allee 1997 p. 71). The real and perceived characteristics of knowledge profoundly affect how knowledge management is defined and deployed within organizations. Discussions about the nature of knowledge and its characteristics and the abundance of definitions illustrate that there is little agreement among writers and practitioners on what knowledge is and therefore what knowledge management entails. Several authors question whether it is actually knowledge rather than information that is managed (Davenport et al 1998) and whether organizations are in fact implementing knowledge management (Nerney 1997). Spender complains that "...the prevailing notion of knowledge seems naively positivistic and that of learning simplistically mechanical. We seem to presume that knowledge is made up of discrete and transferable granules of understanding about reality which can be added to an extant heap of knowledge" (Spender 1996 p. 64). It appears that many organizations adopt this perspective of learning as "mental bricklaying" (Hedberg 1981 p. 4) as a basis for knowledge management. Knowledge is complex and many of its characteristics defy simplistic approaches to knowledge management. In the literature a growing awareness of the complexity of knowledge is evident (Nonaka, Takeuchi 1995, Sveiby 1997).

Organizations have "recipe" knowledge that allows people to know what decisions to make in most situations. This type of explicit knowledge can become insufficient in uncertain situations (Sproull 1981). In a turbulent environment that requires fast decision making organizations therefore have to focus on tacit knowledge. "Organizational knowledge creation involves a continuous interplay between tacit and explicit knowledge" (Inkpen 1996 p. 125). Knowledge is transferred in a social context with the receiver constructing his or her own version of knowledge (Polanyi 1962). Several ways in which tacit knowledge can be made explicit and shared have been suggested (Spender 1996, Stewart 1991, Pickard 1998, Sveiby 1997, Nonaka, Takeuchi 1995, Nonaka 1991). Tacit knowledge lies at the very basis of organizational knowledge creation (Malhotra 1997) and therefore has to be central to knowledge explicit so that it can be shared and renewed. This requires an understanding of how knowledge is formed and how people and organizations learn to use it wisely (Allee 1997). In this way knowledge management can become an effective aid for organizational decision making.

Numerous knowledge management strategies and different views on knowledge management exist. Alavi and Leidner (1999) identify 3 different perspectives on knowledge management. From an information-based perspective knowledge management is about information characteristics and a means of keeping track of who holds knowledge and how to locate them. The technology-based perspective on knowledge management is concerned with information technology infrastructure, while the culture-based perspective associates knowledge management with organizational learning and communication. Hahn and Subramani (2000) propose a framework that defines knowledge management strategies according to the locus of knowledge and the extent to which knowledge is structured. These strategies are supported by different technologies.

As the importance of knowledge management as a strategy to support organizational problem solving and decision making increases, definitions are becoming more comprehensive and encompass all aspects of knowledge creation and usage in organizations. Knowledge management becomes "... a framework within which the organization views all its processes as knowledge processes" (Malhotra 1998 p. 2). A growing number of writers also recognize the importance of social and organizational factors for knowledge management success (Gopal, Gagnon 1995, Davenport et al 1998, Nonaka, Takeuchi 1995). In times of rapid change the demand for effective knowledge management is growing. However, it appears that the increasing pace of change impedes the success of many knowledge management strategies. The knowledge intensive support organizations of the Australian dairy industry provide an example of the varying effectiveness of different knowledge management strategies at a time when the context within which they operate changes at a constantly faster pace.

3. Knowledge management in rural industries

"Farming systems and thinking about farming change continuously" (Schiere et al 1999). Rural industries all over the world are under mounting pressure to increase production in the face of a growing population, consumer demands and environmental considerations. The Australian dairy industry is no exception. Australian dairy farmers are assisted in their quest for improved production and sustainability by a number of organizations that aim to complement farmers' knowledge and experience through scientific research and advice on farm management. Extension advice to clients in rural industries in the past has been based on how certain technologies work in one situation and applying it to other cases. This approach has worked well in improving the productivity and the financial status of dairy farmers. The Queensland dairy industry is leading the world in tropical dairy production. This has been achieved through the development of dairy feeding systems based on research and practical experience. Major improvements in total farm and per cow productivity have been demonstrated in Queensland by extensive use of technologies that have been adapted from applied research programmes usually conducted on research stations. These research projects have included the feeding of supplementary concentrates to dairy cows (Cowan and Davison 1977, Cowan and Davison 1978, Davison *et al.*, 1986, Davison et *al.*, 1991), the application of nitrogen fertiliser to pastures (Chopping *et al.*, 1976, Goodchild *et al.*, 1982, Chopping *et al.*, 1982a and b), the increased use of sires of high genetic merit (Evertt 1981) and the use of temperate pasture and legume species during the winter period (Moss *et al.*, 1985).

However, in recent years the dairy industry has had to significantly shift its focus. Rather than catering exclusively to the needs of farmers and addressing different aspects of production improvement rural support organizations now have to consider the whole production process and research has been directed to include environmental factors and consumer preferences. Several new research topics such as soils and nutrients, forage agronomy, reproduction and management skills have emerged since 1995. This has resulted in a greater awareness of environmental and other supply chain factors by the research and extension organizations, which provide service delivery to the dairy industry. These organizations depend on research funding from the Dairy Research and Development Corporation (DRDC). Their research and extension priorities therefore need to change quickly in order to obtain continuing funding. As a consequence extension advice needs to be rapidly tailored to cater for these changing factors. At the same time the speedy delivery of new research findings to dairy farmers has to be ensured.

Within the knowledge intensive support organizations of the Australian dairy industry several trends in the approach to knowledge management can be observed. Farmers themselves currently use numerous knowledge management strategies and decision support technologies to improve and accelerate access to scientific research, consumer and environmental requirements and experiences. These strategies range from journals and other publications to decision support and expert systems. Recently web sites such as Dairy Web

(http://web1.dairyweb.com.au/emp/dairyweb/logonFrameset10000.htm) have been introduced as a means of improving the timeliness of knowledge dissemination. While there is a growing variety of technologies, there is also less emphasis on maintaining existing knowledge bases in favor of creating new ones. At the same time anecdotal evidence suggests that the role of the extension officers is being diminished (Strachan, 1992; Hannibal and Sriskandarajah, 1992). Members of rural support organizations have argued that due to the increasing technological support for farmers the role of extension officers is becoming less central to knowledge dissemination (G. Johnston pers. comm. 2001). These trends are the result of the fast changing environment in which the industry exists. They also have a direct impact on the success of the knowledge management strategies as an aid for decision making in the current climate of persistent and fast change.

In the past there have been several initiatives to make tacit knowledge more explicit within the northern Australian dairy industry. These include the development of expert systems (Kerr *et al* 1992). However, many of these projects have been unsuccessful due to insufficient follow up effort with regard to marketing the product so as to have enough end users to warrant continued maintenance. Farmers have not adopted agricultural decision support and expert systems as had been anticipated. The authors are engaged in research to identify the barriers to their acceptance and possible strategies to enhance the adoption rate (Kerr et al 2001). One of the major problems affecting the usefulness of knowledge management strategies based on decision support and expert systems has been the increasing effort needed to keep the knowledge bases up-to-date and relevant in the face of new research findings and a changing context.

Walker *et al* (1997) suggest that the creation of corporate knowledge bases through the application of knowledgebased systems methods has the potential to improve training, help establish research priorities, update existing staff knowledge and update the knowledge of client farmers. However, the main problem with this model is the timeliness of the knowledge base and the context in which the advice is given. This could be overcome through continual knowledge base refinement through peer review of existing heuristics in conjunction with knowledge and expertise of people who have experience in addressing the ever-changing goals and objectives of knowledge intensive organizations. For example, it is important that environmental factors be considered when using heuristics developed under the old paradigm of maximizing productivity and farm profit for traditional farmer clients. This requires constant updating of the knowledge bases to reflect these changes. Present technologies such as those described by Walker *et al* (1997) may be inadequate for the rapidly changing extension environment within rural industries.

The effort required not only to keep the knowledge bases up-to-date, but also to reflect the changing research context increases significantly. At the same time farmers have to absorb a wealth of material as well as come to terms with contextual changes for farm management. In an effort to improve the maintainability of knowledge bases the dairy industry support organizations have introduced numerous new applications that provide farmers with a wealth of research findings. Conscious attempts are made to select technologies that allow the knowledge bases to be updated

quickly in order to improve the timeliness of knowledge dissemination and to widen the scope of sharing knowledge between researchers and farmers and their peer groups. So far, not all of these initiatives have been successful.

Knowledge based decision support systems such as DairyPro (Kerr et al 1999 a and b) have been used to capture the heuristics from dairy researchers to help benchmark dairy farms in northern Australia. This method has had some success and the rigor of the developed "rules of thumb" has been assured by the extensive use of a peer review process by farmers, other researchers and extension officers throughout the northern Australian dairy industry (Kerr et al 1999b). Parts of the DairyPro approach (Kerr et al 1999a and b) also address some of the concerns that Spender (1996) and others have expressed regarding the problems associated with the transfer of tacit knowledge. Three estimates of the production potential of each component of the dairy system are provided. These already have the tacit knowledge of the researchers and extension officers and the tacit and local knowledge of farmers built into the final figure based on their knowledge of the amount of milk that can be produced from each component. These estimates take into account soil types, managerial abilities, water availability and any other relevant variables as identified by the experts. Many of the variables are explained in the help files. However, without a full explanation of how the estimate was derived the findings may make little sense within each farmer's particular situation. Farmers need to understand the context of the research before they are able to internalize and apply the knowledge. Scientists also place great value on the context of their research, since it will affect their research questions (Schiere et al 1999). The major challenge is to convey scientific research results and their constantly changing context to farmers, who traditionally base their farm management strategies on their own experience and tacit knowledge or that of their peers.

Timeliness of knowledge dissemination continues to pose a significant problem. The use of web-based applications such as Dairy Web is an attempt to overcome the limitations of other technologies. However, informal discussions with scientists reveal that these have not been as successful as expected. The rigid structure for example, does not allow farmers to search the knowledge bases in an efficient and intuitive way. The design makes few concessions to the way in which farmers may for example wish to find advice on how to deal with a specific problem. Another cause for the lack of success could be that timeliness is still inadequate. Even Internet based technology cannot compete in terms of speed with the direct access to relevant information that farmers have while they are engaged in the day-to-day farming activities. For example providing adverse milk quality results could provide timely feedback to the dairy community in times of heat stress or feed shortages. Such information, however, has been treated as commercial in confidence by milk factories and has not been made available to the general farming community as farmers supplying to other factories are considered competitors. Such information usually becomes public knowledge through informal face-to-face communication long before it is available through the normal reporting processes. This along with the fact that farmers spend most of their time outdoors and are aware of crucial environmental changes rather than being informed of changes through an office environment may be one of the reasons for the low adoption rate of agricultural information systems.

The low adoption rate by Australian farmers of the various information systems and software applications is a recognized problem (Kerr et al 2001). There is an increased effort to develop applications that fit into farmers' work environment and directly address their needs in terms of design, relevance and ease of use (Kerr et al 2001, Cox 1996). However, the limited success of the current approaches to knowledge management may also indicate that the existing strategies are not suitable in a turbulent environment and a climate of rapid change. Approaches to knowledge management in the Australian dairy industry must ensure that advice is tailored to each individual situation and respond to rapid changes such as the expectation of its clients and the general community. Pressures to efficiently and effectively solve problems and make decisions are increasing and access to timely, accurate information is critical. The review of different knowledge management approaches to knowledge management that are appropriate in times of rapid change may require different knowledge management strategies than those currently in place.

4. Factors affecting the development of knowledge management strategies

In a climate of rapid organizational change knowledge intensive organizations in particular need to find a strategy that helps them to respond quickly to new demands and that increases the organization's ability to adapt. In the Australian dairy industry there are several barriers to the success of various knowledge management initiatives to aid decision making. These include the inability of the different technologies to provide the relevant context before research findings can become meaningful to farmers, the lack of timeliness, the problem of keeping existing knowledge bases up-to-date and the differences between the way in which knowledge is used and acquired among the various stakeholder groups.

The implementation of numerous new technology based initiatives to knowledge management has been a direct result of the changing context in which the Australian dairy industry operates. Unfortunately the introduction of different applications and technologies has been frequently at the expense of existing knowledge bases. When faced with radical changes, organizations may consider existing knowledge bases obsolete. In the attempt to change goals, objectives and business processes "old" is quickly replaced with "new". Moreover, the effort required to keep knowledge bases up-to-date may be considered too great. However, their continued importance may be underrated. Some writers maintain that knowledge management tools "… don't really manage knowledge, but help capture, organize, store and transmit source material from which an individual may acquire knowledge" (Gundry, Metes 1996 p. 3). It is this source material that can be used to aid decision making in a new context and become the basis of knowledge creation and that could therefore play a crucial role during times of rapid change. Agricultural scientists for

example use previous research findings, which are reevaluated and reinvestigated based on new or additional variables made relevant by changing paradigms. Farmers base many of their decisions on their own and their peers' past experience and observations. The authors of this paper suggest that it is in fact this characteristic of knowledge that makes the preservation of existing knowledge bases vital.

Not only can existing knowledge in a different context assist in the creation of new knowledge, given the speed of change and the constantly changing requirements it is impossible to predict what may be useful and relevant in the future. The current drought conditions in some areas of Australia for example, have resulted in the publication of both historical and new research findings on how to deal with these events. The value of existing scientific knowledge therefore extends beyond the present well into the future. Knowledge management in a knowledge intensive organization needs to be based on an awareness of the value of its existing knowledge base as much as on acquiring new knowledge specific to its new objectives and practices. The technology driven approaches to knowledge management provide information that farmers then can transform into knowledge within their particular situation. These initiatives should therefore not be abandoned, but rather that it is necessary to understand their limitations. However, technology driven knowledge management provides little assistance in conveying the ever changing context in which decisions need to be made to farmers.

The adoption rate of decision support and expert systems within the Australian farming community is still very low (Kerr et al 2001). Some authors compare knowledge management to a tool that can be successful only, if the users succeed with the tool (Hahn, Subramani 2000). This makes systems acceptance critical. Attempts are under way to increase the acceptance of technological solutions through greater involvement of farmers in their development (Kerr et al 2001). Full acceptance has, however, not yet been achieved. Since the acceptance and success of knowledge management strategies is linked to the adoption of the underlying technologies, major efforts in this area are needed.

Malhotra maintains, "the dominant conception of IT enabled knowledge management is constrained by the very nature of the knowledge creation process" (Malhotra 1997). Knowledge is highly contextual and "... adding context to information is one of the transformations from information to knowledge" (Gundry, Metes 1996 p. 9). Conveying the new context becomes a core issue of successful knowledge management strategies and technologies. Walker *et al* (1997) describe the farming systems research and extension paradigm as a cycle that must be treated as an integrated whole. If knowledge bases reflect changing circumstances farmers could be more readily persuaded to make use of the applications. However, technological solutions to capturing and sharing tacit knowledge are not always successful. Much of the dissatisfaction with knowledge management technology stems from a focus on explicit knowledge. "... IT-driven knowledge management strategies may end up objectifying and calcifying knowledge into static, inert information, thus disregarding altogether the role of tacit knowledge" (Borghoff, Pareschi p. 3). Such a strategy on its own may therefore be inappropriate in a turbulent environment. While providing farmers with information in a variety of formats and media will assist them and is a step in the right direction, the very nature of knowledge, that is, its context dependency makes the acquisition process more difficult. For example the demand to consider the entire rural supply chain means that the effects on milk production of different feeding supplements need to be considered not only in terms of the quantity but also the quality of the product as determined by the consumer.

Successful knowledge management is based on an awareness that multiple channels are used for knowledge transfer, which reinforce each other and that face-to-face contact is important (Davenport et al 1998). During times of rapid change it may be difficult to maintain communication. As people leave the organization or get assigned new responsibilities additional effort to maintain or reestablish communication channels may be necessary. This inherent contradiction that on the one hand knowledge management strategies are designed to cope with organizational change, but also rely for their success on human communication, which is difficult to maintain in turbulent times may be a significant factor for the lack of success of many knowledge management initiatives. Knowledge is transferred in a social context (Polanyi 1962). Since technology cannot handle all communication needs human communication systems need to be developed (Zuckerman 1997). Technology based knowledge management strategies need to be complemented with means that allow people to communicate and interact directly. In the context of the Australian dairy industry communication has to be available to groups of scientists, groups of farmers and most importantly between these groups. This has traditionally been the role of rural extension officers. This research indicates that their role is crucial during times of rapid change and needs to be expanded rather than diminished.

Developers and implementers of knowledge management systems should adopt a practice-oriented approach and "...develop information technology solutions that are consistent with the knowledge work practices of the intended user community" (Schultze, Boland 2000). The involvement of different groups, which use and acquire knowledge and perform their work in different ways, poses a significant problem for knowledge management strategies in rural industries. The format in which knowledge is presented, the importance of tacit versus explicit knowledge and the way in which technology can be incorporated into the work differs greatly. One author of this paper is himself an agricultural scientist and has experienced these differences in his own work. Administrators of governing bodies, technologists, scientists and farmers work in different environments and acquire and use knowledge in different ways. The authors found that each of these groups favors different knowledge management strategies and may also put a different value on existing knowledge bases.

Scientists have a unique approach to their work that sets them apart from other groups (Allen 1997). Scientific knowledge is constantly renewed and expanded. Scientists access knowledge mainly from writings by their peers and from experiments. This calls for strategies that allow agricultural scientists to easily share their knowledge and to use previous findings as a basis for creating new knowledge as the changing context of the rural industry demands. The

results of this research then have to be communicated to farmers in order to help them improve the profitability and sustainability of their farms. However, scientific data may appear irrelevant to farmers who rely to a large extent on experience and intuitive understanding. Knowledge transfer within peer groups and especially to other groups takes time, which in ever changing conditions is not available. In the past extension officers have played a vital role in the dissemination of knowledge and communication among farmers and between farmers and agricultural scientists. As efforts to implement technological solutions increased the role of the extension officers has diminished. It appears, however, that human facilitators need to be accorded an expanding role in conveying the context and maintaining communication. Information and culture-based alternatives to knowledge management (Alavi, Leidner 1999) and a people-centered approach are becoming more important in times of rapid change.

5. Conclusion

Over the past few years the rate of change businesses and organizations experience has increased dramatically. Organizations are looking towards knowledge management as a means to adapt quickly and to support problem solving and decision making in a turbulent and uncertain environment. The Australian dairy industry and its knowledge intensive support organizations are actively searching for knowledge management strategies that will aid them in expanding their research constantly into new areas and transferring this knowledge on a timely basis to farmers. Environmental concerns, consumer preferences, the global economy and a need to improve productivity and sustainability are just some of the issues that farmers and researchers need to address. Current knowledge management strategies have so far provided only limited support. The findings from this research indicate that this lack of success is due to several factors such as the low adoption rate of information technology by farmers, the limitations of technology-based knowledge management approaches and the differences in the types of knowledge used and the work environments of the different stakeholder groups.

Agricultural support organizations are aware of the lack of success of information systems in general and knowledge management technologies in particular. Projects to identify the reasons for failure of individual applications are under way. However, so far there has been no systematic attempt to review the strategies and the usability and usefulness of the various initiatives. Agricultural support organizations need to gain a complete overview of current and proposed knowledge management initiatives. Only this will allow them to determine which strategies are successful and which could become so by being complemented with alternative approaches. It may also indicate which knowledge management strategies are inadequate in a turbulent environment. Since circumstances are constantly changing revaluation and reappraisal have to become an integral part of knowledge management implementation.

The changing context of farm work and agricultural research, the reliance on tacit knowledge by farmers and the increasing speed with which they need to absorb and apply new knowledge makes knowledge management strategies that focus on humans rather than on technological solutions absolutely vital. The Australian dairy industry has to take the needs of its various stakeholder groups into account and most importantly adjust its strategies to facilitate information and knowledge exchange and acquisition by farmers and agricultural scientists. The findings from this research suggest that the knowledge intensive support organizations of the Australian dairy industry need to adopt a combination of strategies in order to enhance the success of knowledge management initiatives to aid decision making. In times of fast changing context the human intermediary becomes essential. The role of rural extension officers should therefore be enhanced and expanded rather than reduced. This does not mean that technology does no longer play an important role. However, technology needs to be selected based on the ease with which knowledge bases can be maintained and its flexibility. At the same time development and implementation of technology-based knowledge management strategies need to involve farmers to a greater extent than in the past. The current approaches that are geared towards improving timeliness of knowledge transfer and the variety of sources that are available are a step in the right direction. However, it may well be the face-to-face communication with extension officers that will increase the likelihood of success of these initiatives as aids to decision making.

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